Google Isolated Sign Language Recognition

Code submitted for group project, DA526, 2023, IITG.

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In [1]:
```
# !pip install itables
```

In [2]:
```
import os
import math
import time
import copy

import numpy as np
import pandas as pd

import torch
from torch import nn
from torch.utils.data import DataLoader, Dataset
from sklearn.model_selection import StratifiedGroupKFold
from sklearn.metrics import confusion_matrix

import matplotlib.pyplot as plt
import seaborn as sns
from itables import init_notebook_mode
import itables.options as itable_opt
from tqdm.notebook import trange, tqdm
```

In [33]:
```
# itable_opt.maxBytes=512*1024
init_notebook_mode(all_interactive=True,connected=False)
```

In [4]:
```
# Install dependencies if working on your own desktop
# Not required on Kaggle
#!pip install pyarrow fastparquet
```

Environment Variables

In [5]:
```
device = "cuda" if torch.cuda.is_available() else "cpu"
device = "mps" if torch.has_mps else device
print(f"Using {device} device")

if device=="cuda":
    !nvidia-smi
```

```
Using cuda device
Fri May 12 22:48:17 2023
+---------------------------------------------------------------------------------------+
| NVIDIA-SMI 531.41                 Driver Version: 531.41       CUDA Version: 12.1     |
|-----------------------------------------+----------------------+----------------------+
| GPU  Name                      TCC/WDDM | Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf            Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                                         |                      |               MIG M. |
|=========================================+======================+======================|
|   0  NVIDIA GeForce RTX 4090       WDDM | 00000000:01:00.0  On |                  Off |
|  0%   38C    P8               16W / 450W|    368MiB / 24564MiB |      1%      Default |
|                                         |                      |                  N/A |
+-----------------------------------------+----------------------+----------------------+

+---------------------------------------------------------------------------------------+
| Processes:                                                                            |
|  GPU   GI   CI        PID   Type   Process name                            GPU Memory |
|        ID   ID                                                             Usage      |
|=======================================================================================|
|    0   N/A  N/A      5692    C+G   ...m Files\Mozilla Firefox\firefox.exe    N/A      |
|    0   N/A  N/A      6532    C+G   ...siveControlPanel\SystemSettings.exe    N/A      |
|    0   N/A  N/A      7612    C+G   C:\Windows\explorer.exe                   N/A      |
|    0   N/A  N/A      8056    C+G   ...nt.CBS_cw5n1h2txyewy\SearchHost.exe    N/A      |
|    0   N/A  N/A      8324    C+G   ...2txyewy\StartMenuExperienceHost.exe    N/A      |
|    0   N/A  N/A     10820    C+G   ...t.LockApp_cw5n1h2txyewy\LockApp.exe    N/A      |
|    0   N/A  N/A     13600    C+G   ...es\Windows Firewall Control\wfc.exe    N/A      |
|    0   N/A  N/A     13820    C+G   ....0_x64__kzh8wxbdkxb8p\DCv2\DCv2.exe    N/A      |
|    0   N/A  N/A     13856    C+G   ...__8wekyb3d8bbwe\WindowsTerminal.exe    N/A      |
+---------------------------------------------------------------------------------------+
```

In [6]:
```
iskaggle = os.environ.get('KAGGLE_KERNEL_RUN_TYPE', '')
myDataDir='data/google_asl_data' if not iskaggle else os.path.join("/kaggle","input","asl-signs")
outputDir="data/output" if not iskaggle else "output"
myLabelFile=os.path.join(myDataDir,"train.csv")
```

Read metadata and define subset

In [34]:
```
# Subset of classes used for analysis
animals="bird,bug,cat,cow,dog,fish,frog,hen,mouse,pig".split(",")

# Reading metadata from csv file
T = pd.read_csv(myLabelFile)

# Limiting analysis to defined subset
T=T.loc[T.sign.isin(animals)]
T.reset_index(drop=True, inplace=True)

# Metadata display
T
```

Out[34]: Show 10 entries Search:

path	participant_id	sequence_id	sign
train_landmark_files/26734/817772057.parquet	26734	817772057	cow
train_landmark_files/25571/1000210073.parquet	25571	1000210073	bird
train_landmark_files/53618/2013144557.parquet	53618	2013144557	mouse
train_landmark_files/49445/1339458431.parquet	49445	1339458431	cow
train_landmark_files/49445/4020597832.parquet	49445	4020597832	cat
train_landmark_files/4718/818224169.parquet	4718	818224169	cow
train_landmark_files/4718/3346295892.parquet	4718	3346295892	dog
train_landmark_files/53618/3346302636.parquet	53618	3346302636	frog
train_landmark_files/26734/1340080611.parquet	26734	1340080611	bug
train_landmark_files/28656/3688448447.parquet	28656	3688448447	hen

Showing 1 to 10 of 2,048 entries (downsampled from 3,904x4 to 2,048x4 as maxBytes=65536)

Previous 1 2 3 4 5 ... 205 Next

Sample data

In [35]:
```
pd.read_parquet(os.path.join(myDataDir,T.path[0]))
```

Out[35]: Show 10 entries Search:

frame	row_id	type	landmark_index	x	y	z
4	4-face-0	face	0	0.542482	0.3836	-0.04054208
4	4-face-1	face	1	0.544677	0.3559	-0.0658552
4	4-face-2	face	2	0.544339	0.366788	-0.03711115
4	4-face-3	face	3	0.536504	0.326103	-0.04548462
4	4-face-4	face	4	0.545293	0.346166	-0.0688558
4	4-face-5	face	5	0.546098	0.334211	-0.0624716
4	4-face-6	face	6	0.547942	0.306503	-0.02604309
4	4-face-7	face	7	0.466159	0.307742	0.02427577
4	4-face-8	face	8	0.548946	0.286766	-0.01562528
4	4-face-9	face	9	0.549553	0.274424	-0.01626663

Showing 1 to 10 of 1,489 entries (downsampled from 24,435x7 to 1,489x7 as maxBytes=65536)

Previous 1 2 3 4 5 ... 149 Next

Constants related to the dataset

In [9]:
```
# number of landmarks per frame (features)
ROWS_PER_FRAME = 543

# Point cloud groups as per data file
face_indices=np.arange(0,468)
lhand_indices=np.arange(468,489)
pose_indices=np.arange(489,522)
rhand_indices=np.arange(522,543)
```

Helper function to read data files

In [10]:
```
def load_relevant_data_subset(pq_path):
    # Only taking 3D coordinates from parquet data file
    data_columns = ['x', 'y', 'z']
    data = pd.read_parquet(pq_path, columns=data_columns)

    # Reshaping to 3D tensor format (frame_number,features,coordinates)
    n_frames = int(len(data) / ROWS_PER_FRAME)
    data = data.values.reshape(n_frames, ROWS_PER_FRAME, len(data_columns))
    return torch.tensor(data.astype(np.float32))
```

Helper class & function for mini-batches

In [11]:
```
class CustomDatasetASL(Dataset):
    def __init__(self, file_paths, labels, data_dir, transform=None, target_transform=None):
        self.file_paths=file_paths
        self.labels=labels
        self.data_dir = data_dir
        self.transform = transform
        self.target_transform = target_transform

    def __len__(self):
        return len(self.file_paths)

    def __getitem__(self, idx):
        file_path = os.path.join(self.data_dir, self.file_paths[idx]+'.npy')
        data = torch.tensor(np.load(file_path))
        label = self.labels[idx]
        if self.transform:
            data = self.transform(data)
        if self.target_transform:
            label = self.target_transform(label)
        return data, label

# Generate mini-batch from list with variable length data
def varLength_collate(batch):
    # Sorting by decreasing order of length
    batch=sorted(batch,key=lambda x:x[0].shape[0],reverse=True)
    (data, target) = zip(*batch)

    # Packing variable length data
    data_pack = nn.utils.rnn.pack_sequence(data, enforce_sorted=True)
    return data_pack, torch.vstack(target)
```

Data and Target transform functions

In [12]:
```
# One-hot encoding
def target_transform(y,classN):
    y=torch.tensor(y,dtype=torch.int64)
    return torch.zeros(classN, dtype=torch.float).scatter_(dim=0, index=y, value=1)

def data_transform(data):
    # Removing un-necessary dimensions
    dataZ=data.squeeze()

    # Normalizing by frame mean and std while ignoring NaN values
    dataZ=(dataZ-dataZ.nanmean(dim=(0,1)))/np.nanstd(dataZ,axis=(0,1))

    # Detecting missing features
    lhand_missing=(dataZ[:,lhand_indices,:].isnan().sum(dim=[1,2]))>0
    rhand_missing=(dataZ[:,rhand_indices,:].isnan().sum(dim=[1,2]))>0
    face_missing=(dataZ[:,face_indices,:].isnan().sum(dim=[1,2]))>0
    handsMissing=lhand_missing&rhand_missing
    face_or_hands_missing=handsMissing|face_missing

    # Filling up missing hand via mirroring other hand about y-axis
    fillMissingRight=np.where((~handsMissing)&(rhand_missing))[0]
    fillMissingLeft=np.where((~handsMissing)&(lhand_missing))[0]
    if len(fillMissingRight)>0:
        dataZ[fillMissingRight[:,np.newaxis],rhand_indices[np.newaxis,:],0]=    \
             -dataZ[fillMissingRight[:,np.newaxis],lhand_indices[np.newaxis,:],0]

        dataZ[fillMissingRight[:,np.newaxis],rhand_indices[np.newaxis,:],1]=    \
             dataZ[fillMissingRight[:,np.newaxis],lhand_indices[np.newaxis,:],1]

        dataZ[fillMissingRight[:,np.newaxis],rhand_indices[np.newaxis,:],2]=    \
             -dataZ[fillMissingRight[:,np.newaxis],lhand_indices[np.newaxis,:],2]
    if len(fillMissingLeft)>0:
        dataZ[fillMissingLeft[:,np.newaxis],lhand_indices[np.newaxis,:],0]=    \
             -dataZ[fillMissingLeft[:,np.newaxis],rhand_indices[np.newaxis,:],0]

        dataZ[fillMissingLeft[:,np.newaxis],lhand_indices[np.newaxis,:],1]=    \
             dataZ[fillMissingLeft[:,np.newaxis],rhand_indices[np.newaxis,:],1]

        dataZ[fillMissingLeft[:,np.newaxis],lhand_indices[np.newaxis,:],2]=    \
             -dataZ[fillMissingLeft[:,np.newaxis],rhand_indices[np.newaxis,:],2]

    # Removing frames without face or both-hands
    dataZ=dataZ[~face_or_hands_missing,:,:]

    # Replacing NaN(s) with zero
    return torch.tensor(np.nan_to_num(dataZ,0.0)).flatten(1)
```

Finding and eliminating useless videos

In [13]:
```
frames=np.zeros(len(T))
missing=np.zeros(len(T))
badVideo=[]
for i in trange(len(T)):
    filePath=os.path.join(myDataDir,T.path[i])
    filePathT=os.path.join(outputDir,T.path[i]+'.npy')
    if not os.path.exists(filePathT):
        data=load_relevant_data_subset(filePath)
        dataT=data_transform(data)
        if(dataT.shape[0]>0):
            os.makedirs(os.path.dirname(filePathT), exist_ok=True)
            with open(filePathT, 'wb') as f:
                np.save(f,np.array(dataT),allow_pickle=False)
        else:
            badVideo.append(i)

print(f"Dropping Videos {badVideo}")
T.drop(badVideo,inplace=True)
T.reset_index(drop=True, inplace=True)
```

100% 3904/3904 [00:00<00:00, 32953.68it/s]

```
Dropping Videos [1129, 2025]
```

Target and Group IDs

In [14]:
```
targets=T.loc[:,"sign"].to_list()
uniqueTarget=list(set(targets))
target_id_map=dict((j,i) for i,j in enumerate(uniqueTarget))
targetIDs=np.array(list(map(lambda x:target_id_map[x],targets)))

groups=T.loc[:,"participant_id"].to_list()
uniqueGroup=list(set(groups))
group_id_map=dict((j,i) for i,j in enumerate(uniqueGroup))
groupIDs=np.array(list(map(lambda x:group_id_map[x],groups)))
```

Stratified Group K-Fold Cross Validation Split Helper Function

In [15]:
```
class SGKF_CV_Splits(object):
    def __init__(self,DataIDs,TargetIDs,GroupIDs,TrainSplits=4,TestSplit=5):
        self.count=TrainSplits
        self.DataIDs=DataIDs
        sgkf1 = StratifiedGroupKFold(n_splits=TestSplit)
        sgkf2 = StratifiedGroupKFold(n_splits=TrainSplits)

        (self.trainValID,self.testID)=next(sgkf1.split(range(0,len(TargetIDs)),
                                                       targetIDs,
                                                       groupIDs))

        self.trainValFolds=sgkf2.split(self.trainValID,
                                       targetIDs[self.trainValID],
                                       groupIDs[self.trainValID])
    def __iter__(self):
        return self
    def __next__(self):
        if self.count > 0:
            (t,v)=next(self.trainValFolds)
            trainID=self.trainValID[t]
            valID=self.trainValID[v]
            self.count -= 1
            return self.DataIDs[trainID], self.DataIDs[valID], self.DataIDs[self.testID]
        else:
            raise StopIteration
```

Full dataset and dataloader

In [16]:
```
fullDataset=CustomDatasetASL(\
                             T.path.to_list(), targetIDs, outputDir,\
                             target_transform=lambda x:target_transform(x,len(uniqueTarget))
                            )
fullDataloader=DataLoader(fullDataset, batch_size=10, shuffle=True, collate_fn=varLength_collate)
```

Train-Validate-Test Split

In [17]:
```
for (tr,va,te) in SGKF_CV_Splits(np.arange(0,len(targetIDs)),targetIDs,groupIDs):
    # Custom Dataset(s)
    trainingDataset=CustomDatasetASL(\
                                     T.path[tr].to_list(), targetIDs[tr], outputDir,\
                                     target_transform=lambda x:target_transform(x,len(uniqueTarget))
                                    )
    validationDataset=CustomDatasetASL(\
                                       T.path[va].to_list(), targetIDs[va], outputDir,\
                                       target_transform=lambda x:target_transform(x,len(uniqueTarget))
                                      )
    testDataset=CustomDatasetASL(\
                                 T.path[te].to_list(), targetIDs[te], outputDir,
                                 target_transform=lambda x:target_transform(x,len(uniqueTarget))
                                )

    # Dataloader with batch size = 10
    trainDataloader=DataLoader(trainingDataset, batch_size=10, shuffle=True, collate_fn=varLength_collate)
    valDataloader  =DataLoader(validationDataset, batch_size=10, shuffle=True, collate_fn=varLength_collate)
    testDataloader =DataLoader(testDataset, batch_size=10, shuffle=True, collate_fn=varLength_collate)
    break
```

LSTM based Neural Netwok

In [18]:
```
class Network_LSTM(nn.Module):
    def __init__(self,inSize,hiddenSize,outSize,rnnLayers=1,dropout=0):
        super(Network_LSTM, self).__init__()
        self.inSize = inSize
        self.hiddenSize = hiddenSize
        self.outSize = outSize
        self.rnnLayers = rnnLayers
        self.dropout = dropout

        # LSTM Layer
        self.rnn = nn.LSTM(inSize,hiddenSize,rnnLayers,batch_first=True,dropout=dropout)

        # Fully Connected Layer
        self.fc = nn.Linear(hiddenSize,outSize,bias=False)

    def forward(self, x):
        x, (hiddenState, cellState) = self.rnn(x)
        x = torch.vstack([k[-1,:] for k in nn.utils.rnn.unpack_sequence(x)])
        x = self.fc(x)
        return x
```

Helper Class for Hyper-Parameter Grid Search

In [19]:
```
class nD_Counter:
    def __init__(self, gridLoc=None, start=0, end=-1):
        assert(len(gridLoc)>0)
        self.dims=len(gridLoc)
        self.gridLoc = gridLoc[::-1]
        self.nds = [len(k) for k in self.gridLoc]
        self.pts = math.prod(self.nds)
        self.i = start
        self.start=start
        self.end=end if end>=0 else (self.pts+end+1)

    def __len__(self):
        return(self.end-self.start)

    def __iter__(self):
        self.ndi = [0]*self.dims
        return self

    def __next__(self):
        i = self.i
        if i == self.end:
            raise StopIteration
        rv=[self.gridLoc[k][self.ndi[k]] for k in range(self.dims)][::-1]
        self.i=i+1
        c=1
        for k in range(self.dims):
            self.ndi[k]+=c
            if self.ndi[k]>=self.nds[k]:
                c=math.floor(self.ndi[k]/self.nds[k])
                self.ndi[k]%=self.nds[k]
            else:
                break
        return rv
```

Training loop helper function

In [20]:
```
def train_model_classification(model,
                dataTrain,
                dataValidate,
                optimizer,
                scheduler=None,
                criterion=torch.nn.CrossEntropyLoss(),
                device='cpu',
                num_epochs=25):
    startTime = time.time()

    numTrain = len(dataTrain.dataset)
    numVal = len(dataValidate.dataset)
    if scheduler is not None:
        schedulerNeedsInput=str(type(scheduler)).find("ReduceLROnPlateau")!=-1

    history=[]
    topModelState = copy.deepcopy(model.state_dict())
    topModelAccuracy = 0.0

    model.to(device)
    for epoch in range(num_epochs):
        print('-' * 80)
        print(f'Epoch {epoch+1}/{num_epochs}')

        tic = time.time()
        model.train()
        trainLoss = 0
        trainTruePositives = 0
        for inputs, targets in dataTrain:
            inputs = inputs.to(device)
            targets = targets.to(device)

            optimizer.zero_grad()
            with torch.set_grad_enabled(True):
                modelOutputs = model(inputs)
                predictedClass = torch.max(modelOutputs, 1)[1]
                loss = criterion(modelOutputs, targets)
                loss.backward()
                optimizer.step()
            trainLoss += loss.item() * targets.size(0)
            trainTruePositives += torch.sum(predictedClass == torch.max(targets,1)[1])
        toc = time.time()
        trainLoss /= numTrain
        trainAccuracy = trainTruePositives.double() / numTrain
        trainTime = toc-tic
        print(f'Training   | Loss: {trainLoss:10.4f} | Accuracy: {trainAccuracy*100:8.4f}% | Elapsed: {trainTime:5.0f}s')

        tic = time.time()
        model.eval()
        valLoss = 0
        valTruePositives = 0
        for inputs, targets in dataValidate:
            inputs = inputs.to(device)
            targets = targets.to(device)

            with torch.set_grad_enabled(False):
                modelOutputs = model(inputs)
                predictedClass = torch.max(modelOutputs, 1)[1]
                loss = criterion(modelOutputs, targets)
            valLoss += loss.item() * len(targets)
            valTruePositives += torch.sum(predictedClass == torch.max(targets,1)[1])
            toc = time.time()

            valLoss /= numVal
            valAccuracy = valTruePositives.double() / numVal
            valTime = toc-tic
            print(f'Validation | Loss: {valLoss:10.4f} | Accuracy: {valAccuracy*100:8.4f}% | Elapsed: {valTime:5.0f}s')

            if scheduler is not None:
                if schedulerNeedsInput:
                    scheduler.step(valLoss)
                else:
                    scheduler.step()

            if valAccuracy > topModelAccuracy:
                topModelAccuracy = valAccuracy
                topModelState = copy.deepcopy(model.state_dict())
            history.append([trainLoss,trainAccuracy,trainTime,valLoss,valAccuracy,valTime])
    time_elapsed = time.time() - startTime
    print("="*80)
    print(f'Training complete in {time_elapsed // 60:.0f}m {time_elapsed % 60:.0f}s')
    print(f'Best model accuracy: {topModelAccuracy*100.0 : .2f}%')
    print("="*80)
    # load best model weights
    model.load_state_dict(topModelState)
    return model, torch.tensor(history)
```

Hyper-parameter grid search

In [21]:
```
# Hyper-parameter grid definition
grid_hiddenSize=np.logspace(7,9,3,base=2).astype('int')
grid_rnnLayers=[1,2]
grid_L2_norm=np.logspace(-4,-2,3,base=10)

# Cross entropy loss for classification
criterion = torch.nn.CrossEntropyLoss()

# Max number of epochs
num_epochs = 75

# Best Model
bestModel=None
bestModelValAccuracy=None
bestModelHyperParameters=None
bestModelTrainHistory=None

# Training History
trainHistoryAll=[]

count=0

for h_hS,h_rL,h_L2 in nD_Counter([grid_hiddenSize,grid_rnnLayers,grid_L2_norm]):
    print("|\n"*5)
    print("="*80)
    print(f'Hidden Size = {h_hS}')
    print(f'RNN Layers = {h_rL}')
    print(f'L2 Regularization Weight = {h_L2}')

    # Model instance
    model=Network_LSTM(inSize=1629,\
                       hiddenSize=h_hS,\
                       outSize=10,\
                       rnnLayers=h_rL).to(device)
    print("-"*80)
    print("RNN Model:")
    print(model)

    # Optimize model by changing parameters of the entire model
    optimizer = torch.optim.Adam(model.parameters(),\
                                 weight_decay=h_L2,\
                                 fused=(device=='cuda'))

    # Learning rate scheduler
    scheduler = torch.optim.lr_scheduler.ReduceLROnPlateau(optimizer,\
                                                           'min',\
                                                           verbose=True)

    # Training Loop
    trainedModel, trainHistory = train_model_classification(model,
                                                            dataTrain=trainDataloader,
                                                            dataValidate=valDataloader,
                                                            optimizer=optimizer,
                                                            scheduler=scheduler,
                                                            criterion=criterion,
                                                            device=device,
                                                            num_epochs=num_epochs
                                                           )

    # Record training history
    trainHistoryAll.append([[h_hS,h_rL,h_L2],trainHistory])
    modelValAccuracy=float(trainHistory[:,4].max())

    # Recording best model
    if (bestModelValAccuracy==None) or (bestModelValAccuracy<modelValAccuracy):
        count+=1
        bestModelValAccuracy=modelValAccuracy
        bestModel=trainedModel
        bestModelHyperParameters=[h_hS,h_rL,h_L2]
        bestModelTrainHistory=trainHistory
        torch.save({'State':bestModel.state_dict(),\
                    'HyperParameters':[h_hS,h_rL,h_L2],\
                    'History':trainHistory},
                   os.path.join(outputDir,'BestModel.pt')
                  )
```

|
|
|
|
|

```
================================================================================
Hidden Size = 128
RNN Layers = 1
L2 Regularization Weight = 0.0001
--------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 128, batch_first=True)
  (fc): Linear(in_features=128, out_features=10, bias=False)
)
--------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     2.0217 | Accuracy:  25.9580% | Elapsed:    12s
Validation | Loss:     1.8810 | Accuracy:  36.1528% | Elapsed:     3s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6755 | Accuracy:  42.6040% | Elapsed:     4s
Validation | Loss:     1.7554 | Accuracy:  36.8349% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4834 | Accuracy:  50.8447% | Elapsed:     4s
Validation | Loss:     1.5957 | Accuracy:  45.2933% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.3297 | Accuracy:  56.4895% | Elapsed:     4s
Validation | Loss:     1.4564 | Accuracy:  45.7026% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.2036 | Accuracy:  60.4862% | Elapsed:     4s
Validation | Loss:     1.4156 | Accuracy:  53.8881% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.1115 | Accuracy:  64.4005% | Elapsed:     4s
Validation | Loss:     1.3133 | Accuracy:  52.1146% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.0424 | Accuracy:  65.6366% | Elapsed:     4s
Validation | Loss:     1.2378 | Accuracy:  60.8458% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9546 | Accuracy:  69.5097% | Elapsed:     4s
Validation | Loss:     1.2532 | Accuracy:  57.1623% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.8881 | Accuracy:  72.3527% | Elapsed:     4s
Validation | Loss:     1.2526 | Accuracy:  56.4802% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8412 | Accuracy:  73.3004% | Elapsed:     4s
Validation | Loss:     1.1791 | Accuracy:  59.0723% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.8055 | Accuracy:  74.0420% | Elapsed:     4s
Validation | Loss:     1.1312 | Accuracy:  59.3452% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.7730 | Accuracy:  75.7314% | Elapsed:     4s
Validation | Loss:     1.0458 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.7072 | Accuracy:  78.2859% | Elapsed:     4s
Validation | Loss:     1.0318 | Accuracy:  64.6658% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.6716 | Accuracy:  80.1813% | Elapsed:     4s
Validation | Loss:     1.0503 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.6449 | Accuracy:  80.4285% | Elapsed:     4s
Validation | Loss:     1.0818 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.6116 | Accuracy:  81.7058% | Elapsed:     4s
Validation | Loss:     0.9591 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.6065 | Accuracy:  82.0354% | Elapsed:     4s
Validation | Loss:     1.0311 | Accuracy:  66.5757% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.5926 | Accuracy:  83.2715% | Elapsed:     4s
Validation | Loss:     0.9525 | Accuracy:  67.6671% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.5730 | Accuracy:  83.4775% | Elapsed:     4s
```

```
Validation | Loss:     0.9192 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.5361 | Accuracy:  84.2604% | Elapsed:     4s
Validation | Loss:     1.0482 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.5295 | Accuracy:  85.2905% | Elapsed:     4s
Validation | Loss:     0.9767 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.5435 | Accuracy:  83.7660% | Elapsed:     4s
Validation | Loss:     1.0420 | Accuracy:  66.8486% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.5072 | Accuracy:  85.6613% | Elapsed:     4s
Validation | Loss:     1.0471 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.4956 | Accuracy:  85.0845% | Elapsed:     4s
Validation | Loss:     0.9253 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.4541 | Accuracy:  87.1858% | Elapsed:     4s
Validation | Loss:     0.7872 | Accuracy:  76.2619% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.4488 | Accuracy:  86.6914% | Elapsed:     4s
Validation | Loss:     0.8371 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.4248 | Accuracy:  87.6803% | Elapsed:     4s
Validation | Loss:     0.9181 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.4359 | Accuracy:  86.8974% | Elapsed:     4s
Validation | Loss:     0.9334 | Accuracy:  70.5321% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.4452 | Accuracy:  87.1446% | Elapsed:     4s
Validation | Loss:     0.8291 | Accuracy:  73.6698% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.4268 | Accuracy:  88.2159% | Elapsed:     4s
Validation | Loss:     1.0195 | Accuracy:  67.1214% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.4374 | Accuracy:  87.1446% | Elapsed:     4s
Validation | Loss:     0.9930 | Accuracy:  66.4393% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.4437 | Accuracy:  86.8974% | Elapsed:     4s
Validation | Loss:     0.9685 | Accuracy:  68.2128% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.4978 | Accuracy:  83.6836% | Elapsed:     4s
Validation | Loss:     0.9343 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.4617 | Accuracy:  85.2905% | Elapsed:     4s
Validation | Loss:     0.9143 | Accuracy:  68.3492% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.4437 | Accuracy:  86.6090% | Elapsed:     4s
Validation | Loss:     0.9599 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.4292 | Accuracy:  87.6803% | Elapsed:     4s
Validation | Loss:     1.0171 | Accuracy:  66.5757% | Elapsed:     1s
Epoch 00036: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3509 | Accuracy:  90.5645% | Elapsed:     4s
Validation | Loss:     0.8588 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3258 | Accuracy:  91.5946% | Elapsed:     4s
Validation | Loss:     0.8855 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3106 | Accuracy:  91.9242% | Elapsed:     4s
Validation | Loss:     0.8216 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.2911 | Accuracy:  92.5422% | Elapsed:     4s
Validation | Loss:     0.8318 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.2885 | Accuracy:  92.7482% | Elapsed:     4s
Validation | Loss:     0.8155 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 42/75
Training   | Loss:     0.2829 | Accuracy:  92.7482% | Elapsed:     4s
Validation | Loss:     0.8107 | Accuracy:  74.6248% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.2780 | Accuracy:  93.0367% | Elapsed:     4s
Validation | Loss:     0.8228 | Accuracy:  74.6248% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2748 | Accuracy:  93.2427% | Elapsed:     4s
Validation | Loss:     0.7970 | Accuracy:  74.6248% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2687 | Accuracy:  93.6959% | Elapsed:     4s
Validation | Loss:     0.8088 | Accuracy:  74.6248% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2679 | Accuracy:  93.4075% | Elapsed:     4s
Validation | Loss:     0.7992 | Accuracy:  74.3520% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2640 | Accuracy:  93.2427% | Elapsed:     4s
Validation | Loss:     0.8202 | Accuracy:  74.2156% | Elapsed:     1s
Epoch 00047: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2521 | Accuracy:  94.4376% | Elapsed:     4s
Validation | Loss:     0.8147 | Accuracy:  74.2156% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2499 | Accuracy:  94.3140% | Elapsed:     4s
Validation | Loss:     0.8161 | Accuracy:  74.2156% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2485 | Accuracy:  94.4376% | Elapsed:     4s
Validation | Loss:     0.8178 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2473 | Accuracy:  94.3964% | Elapsed:     4s
Validation | Loss:     0.8221 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2473 | Accuracy:  94.3552% | Elapsed:     4s
Validation | Loss:     0.8201 | Accuracy:  74.2156% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2462 | Accuracy:  94.2728% | Elapsed:     4s
Validation | Loss:     0.8153 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2457 | Accuracy:  94.3140% | Elapsed:     4s
Validation | Loss:     0.8174 | Accuracy:  74.6248% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.2449 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8144 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.2441 | Accuracy:  94.2728% | Elapsed:     4s
Validation | Loss:     0.8213 | Accuracy:  74.3520% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.2431 | Accuracy:  94.4376% | Elapsed:     4s
Validation | Loss:     0.8067 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.2422 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8145 | Accuracy:  74.7613% | Elapsed:     1s
Epoch 00058: reducing learning rate of group 0 to 1.0000e-06.
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.2400 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.8133 | Accuracy:  74.8977% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.2398 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.8132 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.2397 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.8126 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2395 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.8125 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2394 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.8121 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
```

```
Training   | Loss:     0.2393 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.8123 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2392 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.8121 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2391 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.8118 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.2390 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.8117 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.2389 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.8118 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.2388 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.8114 | Accuracy:  74.7613% | Elapsed:     1s
Epoch 00069: reducing learning rate of group 0 to 1.0000e-07.
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.2386 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.8113 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.2385 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.8114 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.2385 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.8114 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.2385 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.8114 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.2385 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.8114 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.2385 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.8114 | Accuracy:  74.7613% | Elapsed:     1s
===========================================================================
Training complete in 5m 39s
Best model accuracy:  76.26%
===========================================================================
|
|
|
|
|

===========================================================================
Hidden Size = 128
RNN Layers = 1
L2 Regularization Weight = 0.001
---------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 128, batch_first=True)
  (fc): Linear(in_features=128, out_features=10, bias=False)
)
---------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9982 | Accuracy:  27.7297% | Elapsed:     4s
Validation | Loss:     1.9200 | Accuracy:  31.6508% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6680 | Accuracy:  44.5406% | Elapsed:     4s
Validation | Loss:     1.7529 | Accuracy:  38.6085% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4566 | Accuracy:  51.1331% | Elapsed:     4s
Validation | Loss:     1.5578 | Accuracy:  45.1569% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.3036 | Accuracy:  57.0663% | Elapsed:     4s
Validation | Loss:     1.5045 | Accuracy:  45.0205% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1785 | Accuracy:  61.4751% | Elapsed:     4s
Validation | Loss:     1.3508 | Accuracy:  53.2060% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.1109 | Accuracy:  64.9361% | Elapsed:     4s
Validation | Loss:     1.2621 | Accuracy:  54.2974% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.0252 | Accuracy:  66.5019% | Elapsed:     4s
Validation | Loss:     1.1770 | Accuracy:  58.2538% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9591 | Accuracy:  68.5208% | Elapsed:     4s
Validation | Loss:     1.1630 | Accuracy:  61.1187% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.9271 | Accuracy:  70.9518% | Elapsed:     4s
Validation | Loss:     1.1596 | Accuracy:  64.6658% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8729 | Accuracy:  72.9295% | Elapsed:     4s
Validation | Loss:     1.0780 | Accuracy:  63.0286% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.8451 | Accuracy:  74.4953% | Elapsed:     4s
Validation | Loss:     1.1512 | Accuracy:  56.4802% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.8155 | Accuracy:  75.2369% | Elapsed:     4s
Validation | Loss:     1.0996 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.7618 | Accuracy:  77.3383% | Elapsed:     4s
Validation | Loss:     1.0416 | Accuracy:  66.5757% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.7692 | Accuracy:  76.3906% | Elapsed:     4s
Validation | Loss:     1.1736 | Accuracy:  59.3452% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.7510 | Accuracy:  76.8850% | Elapsed:     4s
Validation | Loss:     0.9696 | Accuracy:  66.0300% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.7095 | Accuracy:  79.2748% | Elapsed:     4s
Validation | Loss:     1.0710 | Accuracy:  62.6194% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.6848 | Accuracy:  79.5220% | Elapsed:     4s
Validation | Loss:     0.9301 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.6664 | Accuracy:  80.2225% | Elapsed:     4s
Validation | Loss:     0.9871 | Accuracy:  65.2115% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.6480 | Accuracy:  80.9642% | Elapsed:     4s
Validation | Loss:     0.9903 | Accuracy:  66.7121% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.6429 | Accuracy:  80.9230% | Elapsed:     4s
Validation | Loss:     0.9297 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.6401 | Accuracy:  81.2526% | Elapsed:     4s
Validation | Loss:     0.9110 | Accuracy:  67.9400% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.6242 | Accuracy:  81.5822% | Elapsed:     4s
Validation | Loss:     0.9255 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6130 | Accuracy:  82.8183% | Elapsed:     4s
Validation | Loss:     0.9802 | Accuracy:  67.9400% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.6012 | Accuracy:  82.6947% | Elapsed:     4s
Validation | Loss:     0.9294 | Accuracy:  69.8499% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5789 | Accuracy:  83.2715% | Elapsed:     4s
Validation | Loss:     0.8973 | Accuracy:  68.0764% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.5704 | Accuracy:  83.2303% | Elapsed:     4s
Validation | Loss:     0.9617 | Accuracy:  69.5771% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5432 | Accuracy:  84.6724% | Elapsed:     4s
Validation | Loss:     0.9056 | Accuracy:  69.8499% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.5240 | Accuracy:  85.2081% | Elapsed:     4s
Validation | Loss:     0.9498 | Accuracy:  68.2128% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.5310 | Accuracy:  84.9197% | Elapsed:     4s
```

```
Validation | Loss:     0.9401 | Accuracy:  67.8035% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.5135 | Accuracy:  84.5076% | Elapsed:     4s
Validation | Loss:     0.7874 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.5007 | Accuracy:  85.7849% | Elapsed:     4s
Validation | Loss:     1.0050 | Accuracy:  66.0300% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.5063 | Accuracy:  85.4965% | Elapsed:     4s
Validation | Loss:     1.0057 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.5346 | Accuracy:  84.0544% | Elapsed:     4s
Validation | Loss:     0.8164 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.4776 | Accuracy:  86.8562% | Elapsed:     4s
Validation | Loss:     0.8793 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.4689 | Accuracy:  86.6914% | Elapsed:     4s
Validation | Loss:     0.7723 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.4317 | Accuracy:  87.5155% | Elapsed:     4s
Validation | Loss:     0.7741 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.4548 | Accuracy:  86.8562% | Elapsed:     4s
Validation | Loss:     0.7767 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.4713 | Accuracy:  85.4553% | Elapsed:     4s
Validation | Loss:     0.7766 | Accuracy:  73.3970% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.4356 | Accuracy:  87.6391% | Elapsed:     4s
Validation | Loss:     0.8659 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.4354 | Accuracy:  87.7215% | Elapsed:     4s
Validation | Loss:     0.8977 | Accuracy:  67.9400% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.4480 | Accuracy:  86.5678% | Elapsed:     4s
Validation | Loss:     0.7404 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.4702 | Accuracy:  86.7738% | Elapsed:     4s
Validation | Loss:     0.8637 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.4642 | Accuracy:  86.1970% | Elapsed:     4s
Validation | Loss:     0.8410 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.4915 | Accuracy:  85.5789% | Elapsed:     4s
Validation | Loss:     0.8534 | Accuracy:  73.6698% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.4503 | Accuracy:  87.5567% | Elapsed:     4s
Validation | Loss:     0.9669 | Accuracy:  68.7585% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.4765 | Accuracy:  86.9386% | Elapsed:     4s
Validation | Loss:     0.8740 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.4342 | Accuracy:  87.4742% | Elapsed:     4s
Validation | Loss:     0.8302 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.4478 | Accuracy:  86.9798% | Elapsed:     4s
Validation | Loss:     0.8485 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.4277 | Accuracy:  87.8451% | Elapsed:     4s
Validation | Loss:     0.8379 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.4255 | Accuracy:  88.8752% | Elapsed:     4s
Validation | Loss:     0.7862 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.4350 | Accuracy:  87.8863% | Elapsed:     4s
Validation | Loss:     0.7566 | Accuracy:  75.9891% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
```

```
Training   | Loss:     0.4439 | Accuracy:  88.4219% | Elapsed:     3s
Validation | Loss:     0.7788 | Accuracy:  75.7162% | Elapsed:     1s
Epoch 00052: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.3566 | Accuracy:  91.5122% | Elapsed:     4s
Validation | Loss:     0.7788 | Accuracy:  75.1705% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.3331 | Accuracy:  92.2126% | Elapsed:     4s
Validation | Loss:     0.7664 | Accuracy:  73.9427% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.3259 | Accuracy:  92.3362% | Elapsed:     4s
Validation | Loss:     0.7506 | Accuracy:  74.0791% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.3211 | Accuracy:  92.7070% | Elapsed:     4s
Validation | Loss:     0.7229 | Accuracy:  75.7162% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.3148 | Accuracy:  92.8307% | Elapsed:     4s
Validation | Loss:     0.7448 | Accuracy:  73.9427% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.3099 | Accuracy:  93.2015% | Elapsed:     4s
Validation | Loss:     0.7507 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.3088 | Accuracy:  93.0367% | Elapsed:     4s
Validation | Loss:     0.7713 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.3012 | Accuracy:  93.4899% | Elapsed:     4s
Validation | Loss:     0.7181 | Accuracy:  75.4434% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.3003 | Accuracy:  93.6547% | Elapsed:     4s
Validation | Loss:     0.7783 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2956 | Accuracy:  93.9843% | Elapsed:     4s
Validation | Loss:     0.7424 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2936 | Accuracy:  93.8195% | Elapsed:     4s
Validation | Loss:     0.7748 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.2930 | Accuracy:  93.5311% | Elapsed:     4s
Validation | Loss:     0.7301 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2875 | Accuracy:  93.7783% | Elapsed:     4s
Validation | Loss:     0.7459 | Accuracy:  74.8977% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2847 | Accuracy:  94.0667% | Elapsed:     4s
Validation | Loss:     0.7296 | Accuracy:  74.7613% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.2786 | Accuracy:  94.1080% | Elapsed:     4s
Validation | Loss:     0.7215 | Accuracy:  75.3070% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.2804 | Accuracy:  94.1904% | Elapsed:     4s
Validation | Loss:     0.7152 | Accuracy:  75.3070% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.2760 | Accuracy:  94.6436% | Elapsed:     4s
Validation | Loss:     0.7518 | Accuracy:  73.9427% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.2760 | Accuracy:  94.2316% | Elapsed:     4s
Validation | Loss:     0.7326 | Accuracy:  74.3520% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.2688 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.7494 | Accuracy:  74.3520% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.2673 | Accuracy:  94.3964% | Elapsed:     4s
Validation | Loss:     0.7537 | Accuracy:  73.8063% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.2622 | Accuracy:  94.8084% | Elapsed:     4s
Validation | Loss:     0.7346 | Accuracy:  75.4434% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.2573 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.7188 | Accuracy:  75.0341% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.2502 | Accuracy:  95.0968% | Elapsed:     4s
Validation | Loss:     0.7698 | Accuracy:  73.6698% | Elapsed:     1s
================================================================================
Training complete in 5m 30s
Best model accuracy:  75.99%
================================================================================
|
|
|
|
|

================================================================================
Hidden Size = 128
RNN Layers = 1
L2 Regularization Weight = 0.01
--------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 128, batch_first=True)
  (fc): Linear(in_features=128, out_features=10, bias=False)
)
--------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     2.0392 | Accuracy:  23.6094% | Elapsed:     4s
Validation | Loss:     1.9363 | Accuracy:  32.4693% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.8014 | Accuracy:  35.0639% | Elapsed:     4s
Validation | Loss:     1.7991 | Accuracy:  38.0628% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.6523 | Accuracy:  41.3267% | Elapsed:     4s
Validation | Loss:     1.7856 | Accuracy:  34.1064% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.5388 | Accuracy:  47.4248% | Elapsed:     3s
Validation | Loss:     1.6576 | Accuracy:  46.3847% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.5218 | Accuracy:  48.4961% | Elapsed:     4s
Validation | Loss:     1.7105 | Accuracy:  41.2005% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.4409 | Accuracy:  52.2456% | Elapsed:     4s
Validation | Loss:     1.6241 | Accuracy:  47.2033% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.4099 | Accuracy:  53.8113% | Elapsed:     4s
Validation | Loss:     1.5708 | Accuracy:  45.2933% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.3650 | Accuracy:  56.0775% | Elapsed:     4s
Validation | Loss:     1.6658 | Accuracy:  46.6576% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.3218 | Accuracy:  57.4372% | Elapsed:     4s
Validation | Loss:     1.5226 | Accuracy:  44.4748% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.2894 | Accuracy:  58.1376% | Elapsed:     4s
Validation | Loss:     1.4979 | Accuracy:  50.6139% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.2827 | Accuracy:  59.0853% | Elapsed:     4s
Validation | Loss:     1.5021 | Accuracy:  52.1146% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.2335 | Accuracy:  60.4450% | Elapsed:     4s
Validation | Loss:     1.4630 | Accuracy:  54.7067% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.2134 | Accuracy:  61.5575% | Elapsed:     4s
Validation | Loss:     1.4472 | Accuracy:  56.2074% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.2086 | Accuracy:  61.6811% | Elapsed:     4s
Validation | Loss:     1.4308 | Accuracy:  52.7967% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.1850 | Accuracy:  63.3292% | Elapsed:     4s
Validation | Loss:     1.4503 | Accuracy:  51.8417% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.1701 | Accuracy:  63.1644% | Elapsed:     4s
Validation | Loss:     1.4050 | Accuracy:  57.1623% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.1616 | Accuracy:  63.4116% | Elapsed:     4s
```

```
Validation | Loss:     1.3525 | Accuracy:  51.1596% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.1408 | Accuracy:  65.1422% | Elapsed:     4s
Validation | Loss:     1.3659 | Accuracy:  55.5252% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.1278 | Accuracy:  65.1422% | Elapsed:     4s
Validation | Loss:     1.3170 | Accuracy:  57.0259% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.1291 | Accuracy:  64.9361% | Elapsed:     4s
Validation | Loss:     1.3951 | Accuracy:  52.1146% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.1331 | Accuracy:  64.7301% | Elapsed:     4s
Validation | Loss:     1.3323 | Accuracy:  58.3902% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.1388 | Accuracy:  65.5542% | Elapsed:     4s
Validation | Loss:     1.2856 | Accuracy:  59.3452% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.1052 | Accuracy:  65.5542% | Elapsed:     4s
Validation | Loss:     1.3803 | Accuracy:  53.7517% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.0807 | Accuracy:  66.3782% | Elapsed:     4s
Validation | Loss:     1.3308 | Accuracy:  57.0259% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.0708 | Accuracy:  66.6667% | Elapsed:     4s
Validation | Loss:     1.2738 | Accuracy:  57.8445% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.0727 | Accuracy:  67.9440% | Elapsed:     4s
Validation | Loss:     1.3418 | Accuracy:  54.4338% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.0577 | Accuracy:  68.6444% | Elapsed:     4s
Validation | Loss:     1.2544 | Accuracy:  58.2538% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     1.0436 | Accuracy:  68.1088% | Elapsed:     4s
Validation | Loss:     1.2993 | Accuracy:  55.1160% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.0328 | Accuracy:  69.6745% | Elapsed:     4s
Validation | Loss:     1.2419 | Accuracy:  60.5730% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.0293 | Accuracy:  67.7792% | Elapsed:     4s
Validation | Loss:     1.2371 | Accuracy:  57.4352% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.0556 | Accuracy:  69.4685% | Elapsed:     4s
Validation | Loss:     1.2400 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     1.0341 | Accuracy:  70.1689% | Elapsed:     4s
Validation | Loss:     1.2724 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     1.1329 | Accuracy:  65.2658% | Elapsed:     4s
Validation | Loss:     1.3430 | Accuracy:  58.2538% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     1.1033 | Accuracy:  66.6667% | Elapsed:     4s
Validation | Loss:     1.2942 | Accuracy:  59.2087% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.0686 | Accuracy:  68.6032% | Elapsed:     4s
Validation | Loss:     1.2588 | Accuracy:  61.3915% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     1.0615 | Accuracy:  67.9028% | Elapsed:     4s
Validation | Loss:     1.2799 | Accuracy:  59.2087% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     1.0331 | Accuracy:  68.6444% | Elapsed:     4s
Validation | Loss:     1.2663 | Accuracy:  55.9345% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     1.0126 | Accuracy:  68.7268% | Elapsed:     4s
Validation | Loss:     1.2405 | Accuracy:  61.6644% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     1.0061 | Accuracy:  70.1689% | Elapsed:     4s
Validation | Loss:     1.3422 | Accuracy:  55.6617% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
```

```
Training   | Loss:     1.0334 | Accuracy:  69.5097% | Elapsed:     4s
Validation | Loss:     1.2669 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     1.0275 | Accuracy:  69.1389% | Elapsed:     4s
Validation | Loss:     1.1683 | Accuracy:  65.8936% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     1.0182 | Accuracy:  70.2925% | Elapsed:     4s
Validation | Loss:     1.2341 | Accuracy:  62.4829% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     1.0041 | Accuracy:  70.2101% | Elapsed:     4s
Validation | Loss:     1.2949 | Accuracy:  58.5266% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     1.0070 | Accuracy:  70.4162% | Elapsed:     4s
Validation | Loss:     1.1711 | Accuracy:  62.4829% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9969 | Accuracy:  71.3226% | Elapsed:     4s
Validation | Loss:     1.1905 | Accuracy:  63.5744% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     1.0003 | Accuracy:  70.2101% | Elapsed:     4s
Validation | Loss:     1.1852 | Accuracy:  63.5744% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     1.0052 | Accuracy:  72.1467% | Elapsed:     4s
Validation | Loss:     1.1615 | Accuracy:  66.5757% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.9989 | Accuracy:  71.5698% | Elapsed:     4s
Validation | Loss:     1.2047 | Accuracy:  61.2551% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.9997 | Accuracy:  71.0342% | Elapsed:     4s
Validation | Loss:     1.2078 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.9714 | Accuracy:  72.3527% | Elapsed:     4s
Validation | Loss:     1.2142 | Accuracy:  63.3015% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.9786 | Accuracy:  72.5175% | Elapsed:     4s
Validation | Loss:     1.1576 | Accuracy:  66.3029% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     1.0330 | Accuracy:  70.2101% | Elapsed:     4s
Validation | Loss:     1.2162 | Accuracy:  68.0764% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     1.0207 | Accuracy:  71.5698% | Elapsed:     4s
Validation | Loss:     1.2447 | Accuracy:  64.6658% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     1.0124 | Accuracy:  72.1467% | Elapsed:     4s
Validation | Loss:     1.2381 | Accuracy:  63.9836% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     1.0101 | Accuracy:  72.6411% | Elapsed:     4s
Validation | Loss:     1.2426 | Accuracy:  62.3465% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     1.0378 | Accuracy:  72.3115% | Elapsed:     4s
Validation | Loss:     1.2822 | Accuracy:  58.5266% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     1.0041 | Accuracy:  71.9819% | Elapsed:     4s
Validation | Loss:     1.3502 | Accuracy:  52.6603% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     1.0148 | Accuracy:  72.3115% | Elapsed:     4s
Validation | Loss:     1.2703 | Accuracy:  60.5730% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     1.0087 | Accuracy:  74.2892% | Elapsed:     4s
Validation | Loss:     1.1709 | Accuracy:  67.2578% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     1.0032 | Accuracy:  72.8883% | Elapsed:     4s
Validation | Loss:     1.2145 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.9972 | Accuracy:  72.9707% | Elapsed:     4s
Validation | Loss:     1.2615 | Accuracy:  60.5730% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.9977 | Accuracy:  72.5175% | Elapsed:     4s
Validation | Loss:     1.2178 | Accuracy:  62.4829% | Elapsed:     1s
Epoch 00062: reducing learning rate of group 0 to 1.0000e-04.
```

```
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.9178 | Accuracy:  77.4207% | Elapsed:     4s
Validation | Loss:     1.1891 | Accuracy:  65.4843% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.9068 | Accuracy:  78.2859% | Elapsed:     4s
Validation | Loss:     1.1843 | Accuracy:  65.4843% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.8981 | Accuracy:  78.3272% | Elapsed:     4s
Validation | Loss:     1.1794 | Accuracy:  66.8486% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.8923 | Accuracy:  79.6457% | Elapsed:     4s
Validation | Loss:     1.1705 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.8767 | Accuracy:  79.4396% | Elapsed:     4s
Validation | Loss:     1.1518 | Accuracy:  65.6207% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.8661 | Accuracy:  79.5220% | Elapsed:     4s
Validation | Loss:     1.1216 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.8526 | Accuracy:  79.9753% | Elapsed:     4s
Validation | Loss:     1.1079 | Accuracy:  69.4407% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.8441 | Accuracy:  79.3984% | Elapsed:     4s
Validation | Loss:     1.1334 | Accuracy:  66.4393% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.8317 | Accuracy:  79.8105% | Elapsed:     4s
Validation | Loss:     1.0890 | Accuracy:  67.1214% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.8225 | Accuracy:  80.0165% | Elapsed:     4s
Validation | Loss:     1.1556 | Accuracy:  65.7572% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.8160 | Accuracy:  80.8405% | Elapsed:     4s
Validation | Loss:     1.0955 | Accuracy:  69.5771% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.7965 | Accuracy:  80.9642% | Elapsed:     4s
Validation | Loss:     1.0362 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.7818 | Accuracy:  81.4998% | Elapsed:     4s
Validation | Loss:     1.0905 | Accuracy:  65.8936% | Elapsed:     1s
================================================================================
Training complete in 5m 26s
Best model accuracy:  71.21%
================================================================================
|
|
|
|
|
================================================================================
Hidden Size = 128
RNN Layers = 2
L2 Regularization Weight = 0.0001
--------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 128, num_layers=2, batch_first=True)
  (fc): Linear(in_features=128, out_features=10, bias=False)
)
--------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9219 | Accuracy:  26.9056% | Elapsed:     4s
Validation | Loss:     1.9256 | Accuracy:  22.7831% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5988 | Accuracy:  38.1953% | Elapsed:     4s
Validation | Loss:     1.6099 | Accuracy:  43.1105% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4006 | Accuracy:  47.3012% | Elapsed:     4s
Validation | Loss:     2.1721 | Accuracy:  33.1514% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.3335 | Accuracy:  50.8035% | Elapsed:     4s
Validation | Loss:     1.4545 | Accuracy:  46.9304% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.2546 | Accuracy:  52.7400% | Elapsed:     4s
```

```
Validation | Loss:     1.3842 | Accuracy:  51.8417% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.3094 | Accuracy:  51.2567% | Elapsed:     4s
Validation | Loss:     1.2276 | Accuracy:  53.7517% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.5856 | Accuracy:  43.0573% | Elapsed:     4s
Validation | Loss:     1.5614 | Accuracy:  43.3834% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.4155 | Accuracy:  47.3012% | Elapsed:     4s
Validation | Loss:     1.4589 | Accuracy:  48.9768% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.1655 | Accuracy:  57.5196% | Elapsed:     4s
Validation | Loss:     1.1858 | Accuracy:  59.2087% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.1116 | Accuracy:  59.4973% | Elapsed:     4s
Validation | Loss:     1.2501 | Accuracy:  60.3001% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.0583 | Accuracy:  63.8237% | Elapsed:     4s
Validation | Loss:     1.3154 | Accuracy:  49.6589% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.0356 | Accuracy:  63.2056% | Elapsed:     4s
Validation | Loss:     1.1792 | Accuracy:  56.8895% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.9963 | Accuracy:  64.8537% | Elapsed:     4s
Validation | Loss:     1.3019 | Accuracy:  56.7531% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.9088 | Accuracy:  69.5097% | Elapsed:     4s
Validation | Loss:     1.2205 | Accuracy:  56.7531% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.9624 | Accuracy:  64.7301% | Elapsed:     4s
Validation | Loss:     1.0427 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.8423 | Accuracy:  69.9629% | Elapsed:     4s
Validation | Loss:     1.2082 | Accuracy:  57.9809% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.8288 | Accuracy:  70.9930% | Elapsed:     4s
Validation | Loss:     1.2613 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.8391 | Accuracy:  70.7870% | Elapsed:     4s
Validation | Loss:     0.9930 | Accuracy:  68.3492% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.8174 | Accuracy:  72.1055% | Elapsed:     4s
Validation | Loss:     1.2320 | Accuracy:  57.5716% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.7470 | Accuracy:  74.2068% | Elapsed:     4s
Validation | Loss:     0.9799 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.6920 | Accuracy:  76.5142% | Elapsed:     4s
Validation | Loss:     1.3113 | Accuracy:  60.9823% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.7200 | Accuracy:  76.0198% | Elapsed:     4s
Validation | Loss:     1.0433 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6690 | Accuracy:  77.6679% | Elapsed:     4s
Validation | Loss:     1.1399 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.8045 | Accuracy:  72.6823% | Elapsed:     4s
Validation | Loss:     1.4553 | Accuracy:  60.9823% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.8549 | Accuracy:  71.2402% | Elapsed:     4s
Validation | Loss:     1.0265 | Accuracy:  65.6207% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.7677 | Accuracy:  75.0721% | Elapsed:     4s
Validation | Loss:     1.0996 | Accuracy:  64.9386% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.6707 | Accuracy:  77.7915% | Elapsed:     4s
Validation | Loss:     1.4540 | Accuracy:  58.9359% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
```

```
Training   | Loss:     0.7046 | Accuracy:  75.5253% | Elapsed:     4s
Validation | Loss:     1.1265 | Accuracy:  64.8022% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.6698 | Accuracy:  77.7091% | Elapsed:     4s
Validation | Loss:     1.0506 | Accuracy:  63.7108% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.6062 | Accuracy:  80.0989% | Elapsed:     4s
Validation | Loss:     1.1291 | Accuracy:  64.5293% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.5989 | Accuracy:  80.6757% | Elapsed:     4s
Validation | Loss:     1.1084 | Accuracy:  65.6207% | Elapsed:     1s
Epoch 00031: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.4576 | Accuracy:  85.3729% | Elapsed:     4s
Validation | Loss:     1.0245 | Accuracy:  68.2128% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.4052 | Accuracy:  86.8150% | Elapsed:     4s
Validation | Loss:     1.0032 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.3891 | Accuracy:  87.5155% | Elapsed:     4s
Validation | Loss:     1.0711 | Accuracy:  68.4857% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.3771 | Accuracy:  87.5155% | Elapsed:     4s
Validation | Loss:     1.0533 | Accuracy:  68.4857% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.3658 | Accuracy:  88.5043% | Elapsed:     4s
Validation | Loss:     1.0634 | Accuracy:  67.6671% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3530 | Accuracy:  88.9576% | Elapsed:     4s
Validation | Loss:     1.1102 | Accuracy:  67.9400% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3434 | Accuracy:  89.0812% | Elapsed:     4s
Validation | Loss:     1.1011 | Accuracy:  69.8499% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3304 | Accuracy:  89.6580% | Elapsed:     4s
Validation | Loss:     1.1710 | Accuracy:  67.2578% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.3177 | Accuracy:  90.0288% | Elapsed:     4s
Validation | Loss:     1.1924 | Accuracy:  68.0764% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3163 | Accuracy:  89.7404% | Elapsed:     4s
Validation | Loss:     1.0683 | Accuracy:  68.3492% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.3157 | Accuracy:  89.9052% | Elapsed:     4s
Validation | Loss:     1.0898 | Accuracy:  70.1228% | Elapsed:     1s
Epoch 00042: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.2936 | Accuracy:  90.7705% | Elapsed:     4s
Validation | Loss:     1.1307 | Accuracy:  69.9864% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2857 | Accuracy:  90.9765% | Elapsed:     4s
Validation | Loss:     1.1536 | Accuracy:  69.7135% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2812 | Accuracy:  91.2649% | Elapsed:     4s
Validation | Loss:     1.1711 | Accuracy:  69.3042% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2781 | Accuracy:  91.4297% | Elapsed:     4s
Validation | Loss:     1.1454 | Accuracy:  69.9864% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2759 | Accuracy:  91.5122% | Elapsed:     4s
Validation | Loss:     1.1681 | Accuracy:  69.4407% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2736 | Accuracy:  91.5534% | Elapsed:     4s
Validation | Loss:     1.1814 | Accuracy:  69.3042% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2713 | Accuracy:  91.7594% | Elapsed:     4s
Validation | Loss:     1.1922 | Accuracy:  69.1678% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2695 | Accuracy:  91.9654% | Elapsed:     4s
```

```
Validation | Loss:     1.1943 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2678 | Accuracy:  91.9242% | Elapsed:     4s
Validation | Loss:     1.1936 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2662 | Accuracy:  91.9654% | Elapsed:     4s
Validation | Loss:     1.2038 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2647 | Accuracy:  92.0066% | Elapsed:     4s
Validation | Loss:     1.2077 | Accuracy:  69.0314% | Elapsed:     1s
Epoch 00053: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2615 | Accuracy:  92.0478% | Elapsed:     4s
Validation | Loss:     1.2089 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.2613 | Accuracy:  92.0478% | Elapsed:     4s
Validation | Loss:     1.2098 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.2611 | Accuracy:  92.0478% | Elapsed:     4s
Validation | Loss:     1.2101 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.2609 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2115 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.2607 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2121 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.2605 | Accuracy:  92.0478% | Elapsed:     4s
Validation | Loss:     1.2125 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.2603 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2130 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.2601 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2138 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2599 | Accuracy:  92.0066% | Elapsed:     4s
Validation | Loss:     1.2151 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2597 | Accuracy:  92.0478% | Elapsed:     4s
Validation | Loss:     1.2147 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.2595 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2155 | Accuracy:  68.8950% | Elapsed:     1s
Epoch 00064: reducing learning rate of group 0 to 1.0000e-07.
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2592 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2157 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2592 | Accuracy:  92.1302% | Elapsed:     4s
Validation | Loss:     1.2157 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.2592 | Accuracy:  92.1302% | Elapsed:     4s
Validation | Loss:     1.2157 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.2591 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2157 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.2591 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2158 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.2591 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2159 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.2591 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2159 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.2591 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2159 | Accuracy:  68.8950% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.2591 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2160 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.2590 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2161 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.2590 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     1.2162 | Accuracy:  68.8950% | Elapsed:     1s
Epoch 00075: reducing learning rate of group 0 to 1.0000e-08.
================================================================================
Training complete in 5m 40s
Best model accuracy:  71.35%
================================================================================
|
|
|
|
|

================================================================================
Hidden Size = 128
RNN Layers = 2
L2 Regularization Weight = 0.001
--------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 128, num_layers=2, batch_first=True)
  (fc): Linear(in_features=128, out_features=10, bias=False)
)
--------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9037 | Accuracy:  26.7408% | Elapsed:     4s
Validation | Loss:     1.7560 | Accuracy:  33.2879% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5949 | Accuracy:  40.5851% | Elapsed:     3s
Validation | Loss:     1.6385 | Accuracy:  36.2892% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.5053 | Accuracy:  42.4392% | Elapsed:     4s
Validation | Loss:     1.6041 | Accuracy:  41.8827% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.4174 | Accuracy:  47.3836% | Elapsed:     3s
Validation | Loss:     1.5863 | Accuracy:  43.5198% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.3937 | Accuracy:  46.6831% | Elapsed:     3s
Validation | Loss:     1.6063 | Accuracy:  41.3370% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.2595 | Accuracy:  52.5752% | Elapsed:     3s
Validation | Loss:     1.6375 | Accuracy:  45.9754% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.1783 | Accuracy:  56.0363% | Elapsed:     3s
Validation | Loss:     1.3021 | Accuracy:  50.8868% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.1793 | Accuracy:  56.9839% | Elapsed:     4s
Validation | Loss:     1.3398 | Accuracy:  51.8417% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.2107 | Accuracy:  54.8002% | Elapsed:     3s
Validation | Loss:     1.4552 | Accuracy:  39.6999% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.2326 | Accuracy:  54.9238% | Elapsed:     3s
Validation | Loss:     1.6259 | Accuracy:  42.8377% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.1695 | Accuracy:  57.5196% | Elapsed:     3s
Validation | Loss:     1.4021 | Accuracy:  52.3874% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.1431 | Accuracy:  60.2802% | Elapsed:     3s
Validation | Loss:     1.2580 | Accuracy:  57.5716% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.9965 | Accuracy:  65.8838% | Elapsed:     3s
Validation | Loss:     1.3951 | Accuracy:  56.2074% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.0379 | Accuracy:  63.9061% | Elapsed:     4s
Validation | Loss:     1.3899 | Accuracy:  49.3861% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
```

```
Training   | Loss:     1.1126 | Accuracy:  61.8047% | Elapsed:     4s
Validation | Loss:     1.3311 | Accuracy:  55.7981% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.0288 | Accuracy:  62.3403% | Elapsed:     4s
Validation | Loss:     1.1940 | Accuracy:  57.2988% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.9625 | Accuracy:  66.8315% | Elapsed:     4s
Validation | Loss:     1.3678 | Accuracy:  52.7967% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.8933 | Accuracy:  69.6333% | Elapsed:     4s
Validation | Loss:     1.1554 | Accuracy:  59.4816% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.9015 | Accuracy:  69.5921% | Elapsed:     3s
Validation | Loss:     1.2633 | Accuracy:  57.7080% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.8997 | Accuracy:  69.3449% | Elapsed:     3s
Validation | Loss:     1.2937 | Accuracy:  57.5716% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.7818 | Accuracy:  74.0008% | Elapsed:     4s
Validation | Loss:     1.3038 | Accuracy:  55.2524% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.8278 | Accuracy:  70.9106% | Elapsed:     4s
Validation | Loss:     1.2006 | Accuracy:  59.3452% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.7542 | Accuracy:  74.9073% | Elapsed:     4s
Validation | Loss:     1.0600 | Accuracy:  64.3929% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.6914 | Accuracy:  77.0087% | Elapsed:     4s
Validation | Loss:     1.6276 | Accuracy:  53.3424% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.7150 | Accuracy:  75.8550% | Elapsed:     4s
Validation | Loss:     1.8510 | Accuracy:  37.1078% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.9242 | Accuracy:  68.4384% | Elapsed:     4s
Validation | Loss:     1.3829 | Accuracy:  58.1173% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.8579 | Accuracy:  70.4986% | Elapsed:     4s
Validation | Loss:     1.2158 | Accuracy:  55.7981% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.8411 | Accuracy:  72.5999% | Elapsed:     3s
Validation | Loss:     1.1259 | Accuracy:  62.8922% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.7836 | Accuracy:  73.4652% | Elapsed:     4s
Validation | Loss:     1.3156 | Accuracy:  55.3888% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.6905 | Accuracy:  76.6378% | Elapsed:     4s
Validation | Loss:     1.9548 | Accuracy:  37.1078% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.0032 | Accuracy:  67.2023% | Elapsed:     4s
Validation | Loss:     1.2344 | Accuracy:  55.9345% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.8336 | Accuracy:  72.2291% | Elapsed:     3s
Validation | Loss:     1.0530 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.8042 | Accuracy:  74.2480% | Elapsed:     4s
Validation | Loss:     1.1760 | Accuracy:  58.6630% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.6638 | Accuracy:  78.4096% | Elapsed:     4s
Validation | Loss:     1.1701 | Accuracy:  65.2115% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.5910 | Accuracy:  81.4998% | Elapsed:     4s
Validation | Loss:     1.2678 | Accuracy:  62.3465% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.5976 | Accuracy:  80.4697% | Elapsed:     4s
Validation | Loss:     1.2107 | Accuracy:  61.2551% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.5872 | Accuracy:  80.6345% | Elapsed:     4s
Validation | Loss:     0.9540 | Accuracy:  69.4407% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 38/75
Training   | Loss:     0.6089 | Accuracy:  79.2336% | Elapsed:     4s
Validation | Loss:     1.1390 | Accuracy:  64.6658% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.6961 | Accuracy:  76.2670% | Elapsed:     4s
Validation | Loss:     1.2117 | Accuracy:  58.9359% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.6679 | Accuracy:  77.7915% | Elapsed:     4s
Validation | Loss:     0.9100 | Accuracy:  70.9413% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.5460 | Accuracy:  82.2002% | Elapsed:     4s
Validation | Loss:     1.1437 | Accuracy:  64.2565% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.5431 | Accuracy:  82.9419% | Elapsed:     4s
Validation | Loss:     0.9996 | Accuracy:  71.4870% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.4743 | Accuracy:  83.7660% | Elapsed:     4s
Validation | Loss:     0.8998 | Accuracy:  73.9427% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.5598 | Accuracy:  81.7470% | Elapsed:     4s
Validation | Loss:     0.8414 | Accuracy:  73.8063% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.5363 | Accuracy:  83.6012% | Elapsed:     4s
Validation | Loss:     1.1415 | Accuracy:  66.5757% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.5847 | Accuracy:  81.7470% | Elapsed:     4s
Validation | Loss:     0.8257 | Accuracy:  72.8513% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.4933 | Accuracy:  84.5488% | Elapsed:     4s
Validation | Loss:     1.0239 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.5422 | Accuracy:  82.1590% | Elapsed:     4s
Validation | Loss:     0.8661 | Accuracy:  71.3506% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.4819 | Accuracy:  85.0433% | Elapsed:     4s
Validation | Loss:     0.9086 | Accuracy:  68.4857% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.5969 | Accuracy:  80.3049% | Elapsed:     4s
Validation | Loss:     0.9310 | Accuracy:  67.6671% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.4800 | Accuracy:  84.8785% | Elapsed:     4s
Validation | Loss:     0.9973 | Accuracy:  69.4407% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.4803 | Accuracy:  84.5488% | Elapsed:     4s
Validation | Loss:     0.8308 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.4276 | Accuracy:  86.6914% | Elapsed:     4s
Validation | Loss:     1.0657 | Accuracy:  68.4857% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.4135 | Accuracy:  86.6502% | Elapsed:     4s
Validation | Loss:     0.8812 | Accuracy:  73.3970% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.4635 | Accuracy:  85.6201% | Elapsed:     4s
Validation | Loss:     0.9897 | Accuracy:  66.7121% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.4134 | Accuracy:  87.3918% | Elapsed:     4s
Validation | Loss:     0.8660 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.4158 | Accuracy:  87.2270% | Elapsed:     4s
Validation | Loss:     1.0033 | Accuracy:  68.6221% | Elapsed:     1s
Epoch 00057: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.2766 | Accuracy:  92.3774% | Elapsed:     4s
Validation | Loss:     0.9145 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.2716 | Accuracy:  92.5010% | Elapsed:     4s
Validation | Loss:     0.8925 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.2494 | Accuracy:  93.3663% | Elapsed:     4s
```

```
Validation | Loss:     0.8906 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.2359 | Accuracy:  93.5723% | Elapsed:     4s
Validation | Loss:     0.9400 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2304 | Accuracy:  93.4075% | Elapsed:     4s
Validation | Loss:     1.0184 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2242 | Accuracy:  94.0667% | Elapsed:     4s
Validation | Loss:     0.9413 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.2167 | Accuracy:  93.9843% | Elapsed:     4s
Validation | Loss:     0.9612 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2110 | Accuracy:  94.1904% | Elapsed:     4s
Validation | Loss:     0.9202 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2063 | Accuracy:  94.6024% | Elapsed:     4s
Validation | Loss:     0.9292 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1966 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     1.0332 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1923 | Accuracy:  94.9732% | Elapsed:     4s
Validation | Loss:     0.9515 | Accuracy:  73.2606% | Elapsed:     1s
Epoch 00068: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1800 | Accuracy:  95.4265% | Elapsed:     4s
Validation | Loss:     0.9891 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1774 | Accuracy:  95.5089% | Elapsed:     4s
Validation | Loss:     0.9858 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1760 | Accuracy:  95.4677% | Elapsed:     4s
Validation | Loss:     0.9995 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1749 | Accuracy:  95.6325% | Elapsed:     4s
Validation | Loss:     1.0008 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1739 | Accuracy:  95.5089% | Elapsed:     4s
Validation | Loss:     1.0122 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1727 | Accuracy:  95.6737% | Elapsed:     4s
Validation | Loss:     1.0110 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1715 | Accuracy:  95.6325% | Elapsed:     4s
Validation | Loss:     1.0321 | Accuracy:  72.7149% | Elapsed:     1s
================================================================================
Training complete in 5m 33s
Best model accuracy:  73.94%
================================================================================
|
|
|
|
|

================================================================================
Hidden Size = 128
RNN Layers = 2
L2 Regularization Weight = 0.01
--------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 128, num_layers=2, batch_first=True)
  (fc): Linear(in_features=128, out_features=10, bias=False)
)
--------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9839 | Accuracy:  22.9089% | Elapsed:     4s
Validation | Loss:     2.0278 | Accuracy:  23.7381% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.7522 | Accuracy:  33.9514% | Elapsed:     4s
Validation | Loss:     1.8401 | Accuracy:  30.1501% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 3/75
Training   | Loss:     1.5767 | Accuracy:  38.2777% | Elapsed:     4s
Validation | Loss:     1.5261 | Accuracy:  41.8827% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.5271 | Accuracy:  41.9448% | Elapsed:     4s
Validation | Loss:     1.6445 | Accuracy:  37.6535% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.4326 | Accuracy:  46.9304% | Elapsed:     4s
Validation | Loss:     1.5285 | Accuracy:  43.9291% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.4498 | Accuracy:  43.9637% | Elapsed:     4s
Validation | Loss:     1.6732 | Accuracy:  40.2456% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.4571 | Accuracy:  46.4771% | Elapsed:     4s
Validation | Loss:     1.5621 | Accuracy:  43.6562% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.3334 | Accuracy:  49.4850% | Elapsed:     4s
Validation | Loss:     1.4966 | Accuracy:  44.4748% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.3050 | Accuracy:  51.6687% | Elapsed:     4s
Validation | Loss:     1.6778 | Accuracy:  39.5634% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.8445 | Accuracy:  34.2398% | Elapsed:     4s
Validation | Loss:     1.8490 | Accuracy:  34.7885% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.5746 | Accuracy:  44.5818% | Elapsed:     4s
Validation | Loss:     1.6157 | Accuracy:  40.2456% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.9211 | Accuracy:  27.5237% | Elapsed:     4s
Validation | Loss:     1.9388 | Accuracy:  24.6930% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.7114 | Accuracy:  32.6741% | Elapsed:     4s
Validation | Loss:     1.7004 | Accuracy:  36.2892% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.5963 | Accuracy:  38.7309% | Elapsed:     4s
Validation | Loss:     1.8310 | Accuracy:  29.8772% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.5279 | Accuracy:  41.3679% | Elapsed:     4s
Validation | Loss:     1.7398 | Accuracy:  28.6494% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.4501 | Accuracy:  45.0350% | Elapsed:     4s
Validation | Loss:     1.5794 | Accuracy:  38.6085% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.3487 | Accuracy:  49.8558% | Elapsed:     4s
Validation | Loss:     1.5720 | Accuracy:  41.8827% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.5999 | Accuracy:  39.3078% | Elapsed:     4s
Validation | Loss:     1.8535 | Accuracy:  32.8786% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.4667 | Accuracy:  42.8925% | Elapsed:     4s
Validation | Loss:     1.5361 | Accuracy:  39.5634% | Elapsed:     1s
Epoch 00019: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.2752 | Accuracy:  51.0919% | Elapsed:     4s
Validation | Loss:     1.4874 | Accuracy:  45.0205% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.2147 | Accuracy:  53.8525% | Elapsed:     4s
Validation | Loss:     1.4824 | Accuracy:  44.7476% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.1646 | Accuracy:  58.3848% | Elapsed:     4s
Validation | Loss:     1.3944 | Accuracy:  47.8854% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.1273 | Accuracy:  60.1978% | Elapsed:     4s
Validation | Loss:     1.4225 | Accuracy:  49.2497% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.1195 | Accuracy:  61.1454% | Elapsed:     4s
Validation | Loss:     1.4088 | Accuracy:  48.4311% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.0714 | Accuracy:  62.6288% | Elapsed:     4s
```

```
Validation | Loss:     1.4279 | Accuracy:  48.5675% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.0580 | Accuracy:  63.3292% | Elapsed:     4s
Validation | Loss:     1.3581 | Accuracy:  51.1596% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.0271 | Accuracy:  65.5542% | Elapsed:     4s
Validation | Loss:     1.3583 | Accuracy:  52.2510% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     1.0240 | Accuracy:  64.4005% | Elapsed:     4s
Validation | Loss:     1.3451 | Accuracy:  48.7040% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.0346 | Accuracy:  64.5653% | Elapsed:     4s
Validation | Loss:     1.3483 | Accuracy:  51.2960% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.9900 | Accuracy:  65.5542% | Elapsed:     4s
Validation | Loss:     1.3188 | Accuracy:  51.1596% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.0007 | Accuracy:  65.0597% | Elapsed:     4s
Validation | Loss:     1.3438 | Accuracy:  53.7517% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.9710 | Accuracy:  66.2134% | Elapsed:     4s
Validation | Loss:     1.3796 | Accuracy:  47.4761% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.9956 | Accuracy:  64.2769% | Elapsed:     4s
Validation | Loss:     1.3060 | Accuracy:  54.8431% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.9641 | Accuracy:  67.3671% | Elapsed:     4s
Validation | Loss:     1.3930 | Accuracy:  51.9782% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.0369 | Accuracy:  64.3181% | Elapsed:     4s
Validation | Loss:     1.3148 | Accuracy:  52.6603% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.9699 | Accuracy:  66.7491% | Elapsed:     4s
Validation | Loss:     1.2621 | Accuracy:  53.8881% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.9425 | Accuracy:  67.2435% | Elapsed:     4s
Validation | Loss:     1.2695 | Accuracy:  55.9345% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.9210 | Accuracy:  68.3972% | Elapsed:     4s
Validation | Loss:     1.3247 | Accuracy:  51.8417% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.9466 | Accuracy:  67.2023% | Elapsed:     4s
Validation | Loss:     1.2660 | Accuracy:  58.3902% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.9236 | Accuracy:  68.2324% | Elapsed:     4s
Validation | Loss:     1.2317 | Accuracy:  57.7080% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.9095 | Accuracy:  68.7268% | Elapsed:     4s
Validation | Loss:     1.3368 | Accuracy:  52.9332% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.8969 | Accuracy:  69.0977% | Elapsed:     4s
Validation | Loss:     1.3189 | Accuracy:  54.5703% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.8874 | Accuracy:  70.4574% | Elapsed:     4s
Validation | Loss:     1.2186 | Accuracy:  57.8445% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.8499 | Accuracy:  71.6110% | Elapsed:     4s
Validation | Loss:     1.2316 | Accuracy:  56.3438% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9319 | Accuracy:  68.0676% | Elapsed:     4s
Validation | Loss:     1.2483 | Accuracy:  54.9795% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.8686 | Accuracy:  70.2925% | Elapsed:     4s
Validation | Loss:     1.2741 | Accuracy:  53.3424% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.8884 | Accuracy:  70.1277% | Elapsed:     4s
Validation | Loss:     1.2462 | Accuracy:  57.2988% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
```

```
Training   | Loss:     0.8394 | Accuracy:  71.2402% | Elapsed:     4s
Validation | Loss:     1.1532 | Accuracy:  56.6166% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.8270 | Accuracy:  72.3939% | Elapsed:     4s
Validation | Loss:     1.2334 | Accuracy:  57.4352% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.9518 | Accuracy:  68.5620% | Elapsed:     4s
Validation | Loss:     1.1724 | Accuracy:  56.6166% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.9261 | Accuracy:  69.0564% | Elapsed:     4s
Validation | Loss:     1.2577 | Accuracy:  56.7531% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.8289 | Accuracy:  72.8059% | Elapsed:     4s
Validation | Loss:     1.3731 | Accuracy:  53.4789% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.8330 | Accuracy:  71.8583% | Elapsed:     4s
Validation | Loss:     1.2101 | Accuracy:  57.1623% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.7980 | Accuracy:  72.6411% | Elapsed:     4s
Validation | Loss:     1.1932 | Accuracy:  56.8895% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.7885 | Accuracy:  73.9184% | Elapsed:     3s
Validation | Loss:     1.1846 | Accuracy:  58.9359% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.7803 | Accuracy:  74.5777% | Elapsed:     3s
Validation | Loss:     1.4264 | Accuracy:  51.0232% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.8694 | Accuracy:  70.0453% | Elapsed:     3s
Validation | Loss:     1.2756 | Accuracy:  54.1610% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.8097 | Accuracy:  74.0832% | Elapsed:     3s
Validation | Loss:     1.1118 | Accuracy:  59.2087% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.7830 | Accuracy:  75.2781% | Elapsed:     4s
Validation | Loss:     1.2646 | Accuracy:  54.1610% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.7695 | Accuracy:  75.1133% | Elapsed:     4s
Validation | Loss:     1.1743 | Accuracy:  59.2087% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.7351 | Accuracy:  76.1846% | Elapsed:     4s
Validation | Loss:     1.1924 | Accuracy:  59.2087% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.7629 | Accuracy:  74.7013% | Elapsed:     3s
Validation | Loss:     1.2728 | Accuracy:  57.9809% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.7240 | Accuracy:  76.7202% | Elapsed:     3s
Validation | Loss:     1.2632 | Accuracy:  55.1160% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.7662 | Accuracy:  75.2781% | Elapsed:     4s
Validation | Loss:     1.1347 | Accuracy:  61.2551% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     1.0022 | Accuracy:  65.9662% | Elapsed:     3s
Validation | Loss:     1.2052 | Accuracy:  57.7080% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.8111 | Accuracy:  73.2180% | Elapsed:     4s
Validation | Loss:     1.2645 | Accuracy:  55.7981% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.7687 | Accuracy:  75.5253% | Elapsed:     4s
Validation | Loss:     1.2409 | Accuracy:  57.4352% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.8331 | Accuracy:  71.7759% | Elapsed:     4s
Validation | Loss:     1.1693 | Accuracy:  59.6180% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.7536 | Accuracy:  75.0309% | Elapsed:     3s
Validation | Loss:     1.2192 | Accuracy:  56.8895% | Elapsed:     1s
Epoch 00069: reducing learning rate of group 0 to 1.0000e-05.
-------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.7018 | Accuracy:  78.1623% | Elapsed:     4s
Validation | Loss:     1.1737 | Accuracy:  59.4816% | Elapsed:     1s
```

```
------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.7026 | Accuracy:  78.2035% | Elapsed:     3s
Validation | Loss:     1.1904 | Accuracy:  58.5266% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.6878 | Accuracy:  78.4508% | Elapsed:     3s
Validation | Loss:     1.1873 | Accuracy:  58.5266% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.6838 | Accuracy:  79.1512% | Elapsed:     3s
Validation | Loss:     1.1804 | Accuracy:  59.2087% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.6774 | Accuracy:  79.0688% | Elapsed:     3s
Validation | Loss:     1.1773 | Accuracy:  59.2087% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.6729 | Accuracy:  78.9452% | Elapsed:     4s
Validation | Loss:     1.1925 | Accuracy:  58.6630% | Elapsed:     1s
==============================================================================
Training complete in 5m 36s
Best model accuracy:  61.26%
==============================================================================
|
|
|
|
|
==============================================================================
Hidden Size = 256
RNN Layers = 1
L2 Regularization Weight = 0.0001
------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 256, batch_first=True)
  (fc): Linear(in_features=256, out_features=10, bias=False)
)
------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9630 | Accuracy:  26.9056% | Elapsed:     3s
Validation | Loss:     1.8317 | Accuracy:  38.7449% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6183 | Accuracy:  44.4994% | Elapsed:     4s
Validation | Loss:     1.6647 | Accuracy:  37.7899% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3743 | Accuracy:  52.5340% | Elapsed:     4s
Validation | Loss:     1.4560 | Accuracy:  44.2019% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.1985 | Accuracy:  59.4149% | Elapsed:     4s
Validation | Loss:     1.3598 | Accuracy:  53.6153% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.0668 | Accuracy:  65.5130% | Elapsed:     4s
Validation | Loss:     1.2462 | Accuracy:  54.1610% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     0.9511 | Accuracy:  70.3749% | Elapsed:     3s
Validation | Loss:     1.1506 | Accuracy:  60.8458% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.8978 | Accuracy:  72.1467% | Elapsed:     4s
Validation | Loss:     1.1122 | Accuracy:  63.1651% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.8272 | Accuracy:  74.8249% | Elapsed:     4s
Validation | Loss:     1.0274 | Accuracy:  69.3042% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.7633 | Accuracy:  77.8739% | Elapsed:     4s
Validation | Loss:     0.9590 | Accuracy:  71.4870% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.7548 | Accuracy:  76.6790% | Elapsed:     4s
Validation | Loss:     1.0917 | Accuracy:  62.4829% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.7298 | Accuracy:  77.1735% | Elapsed:     4s
Validation | Loss:     0.9474 | Accuracy:  67.5307% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.6789 | Accuracy:  78.9452% | Elapsed:     4s
Validation | Loss:     0.9486 | Accuracy:  67.3943% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.6499 | Accuracy:  80.2225% | Elapsed:     4s
```

```
Validation | Loss:     0.9047 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.5857 | Accuracy:  82.6535% | Elapsed:     4s
Validation | Loss:     0.9598 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.5678 | Accuracy:  83.0243% | Elapsed:     4s
Validation | Loss:     0.9419 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.5234 | Accuracy:  85.2493% | Elapsed:     4s
Validation | Loss:     0.8949 | Accuracy:  70.5321% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.5362 | Accuracy:  83.9308% | Elapsed:     4s
Validation | Loss:     0.9635 | Accuracy:  65.6207% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.5334 | Accuracy:  83.6836% | Elapsed:     4s
Validation | Loss:     0.9357 | Accuracy:  67.8035% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.4986 | Accuracy:  85.7025% | Elapsed:     4s
Validation | Loss:     0.9413 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.5153 | Accuracy:  85.0021% | Elapsed:     4s
Validation | Loss:     0.8932 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.4824 | Accuracy:  86.3206% | Elapsed:     4s
Validation | Loss:     0.8420 | Accuracy:  70.2592% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.4679 | Accuracy:  86.9386% | Elapsed:     4s
Validation | Loss:     0.8249 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.4553 | Accuracy:  87.1446% | Elapsed:     4s
Validation | Loss:     0.8648 | Accuracy:  70.2592% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.4346 | Accuracy:  87.4330% | Elapsed:     4s
Validation | Loss:     0.8256 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.4103 | Accuracy:  88.3395% | Elapsed:     4s
Validation | Loss:     0.8843 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.3846 | Accuracy:  89.8640% | Elapsed:     4s
Validation | Loss:     1.0140 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.3718 | Accuracy:  89.3284% | Elapsed:     4s
Validation | Loss:     0.8581 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.3597 | Accuracy:  89.4520% | Elapsed:     4s
Validation | Loss:     0.7182 | Accuracy:  77.7626% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.3790 | Accuracy:  88.6279% | Elapsed:     4s
Validation | Loss:     1.0291 | Accuracy:  64.2565% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.3891 | Accuracy:  88.4219% | Elapsed:     4s
Validation | Loss:     0.7027 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.3565 | Accuracy:  90.0700% | Elapsed:     4s
Validation | Loss:     0.8766 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.3696 | Accuracy:  89.8228% | Elapsed:     4s
Validation | Loss:     0.8419 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.3609 | Accuracy:  89.7816% | Elapsed:     4s
Validation | Loss:     0.7158 | Accuracy:  77.0805% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.3537 | Accuracy:  90.3585% | Elapsed:     3s
Validation | Loss:     0.7728 | Accuracy:  73.9427% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.3687 | Accuracy:  88.7927% | Elapsed:     4s
Validation | Loss:     0.8031 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
```

```
Training   | Loss:     0.3708 | Accuracy:  89.3284% | Elapsed:     4s
Validation | Loss:     0.8144 | Accuracy:  73.5334% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3516 | Accuracy:  89.9876% | Elapsed:     4s
Validation | Loss:     0.7894 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3495 | Accuracy:  90.1525% | Elapsed:     4s
Validation | Loss:     0.7279 | Accuracy:  75.1705% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3350 | Accuracy:  90.7293% | Elapsed:     4s
Validation | Loss:     0.8287 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.3281 | Accuracy:  90.3585% | Elapsed:     4s
Validation | Loss:     0.7472 | Accuracy:  76.1255% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3596 | Accuracy:  89.7404% | Elapsed:     4s
Validation | Loss:     0.8784 | Accuracy:  72.7149% | Elapsed:     1s
Epoch 00041: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.2808 | Accuracy:  93.2015% | Elapsed:     3s
Validation | Loss:     0.7314 | Accuracy:  76.1255% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.2673 | Accuracy:  93.2427% | Elapsed:     4s
Validation | Loss:     0.7136 | Accuracy:  76.9441% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2611 | Accuracy:  93.5311% | Elapsed:     4s
Validation | Loss:     0.7119 | Accuracy:  77.0805% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2555 | Accuracy:  93.9843% | Elapsed:     4s
Validation | Loss:     0.7272 | Accuracy:  76.6712% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2479 | Accuracy:  93.7783% | Elapsed:     4s
Validation | Loss:     0.7502 | Accuracy:  75.7162% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2418 | Accuracy:  94.3140% | Elapsed:     4s
Validation | Loss:     0.7426 | Accuracy:  75.7162% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2359 | Accuracy:  94.3552% | Elapsed:     4s
Validation | Loss:     0.7759 | Accuracy:  75.4434% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2325 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     0.7357 | Accuracy:  77.3533% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2270 | Accuracy:  94.7672% | Elapsed:     4s
Validation | Loss:     0.7033 | Accuracy:  77.3533% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2208 | Accuracy:  95.2616% | Elapsed:     4s
Validation | Loss:     0.7224 | Accuracy:  76.8076% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2152 | Accuracy:  94.8908% | Elapsed:     4s
Validation | Loss:     0.7212 | Accuracy:  77.4898% | Elapsed:     1s
Epoch 00052: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2033 | Accuracy:  95.4265% | Elapsed:     4s
Validation | Loss:     0.7209 | Accuracy:  78.0355% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2004 | Accuracy:  95.4677% | Elapsed:     4s
Validation | Loss:     0.7218 | Accuracy:  77.8990% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1992 | Accuracy:  95.4265% | Elapsed:     4s
Validation | Loss:     0.7159 | Accuracy:  78.3083% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1982 | Accuracy:  95.5501% | Elapsed:     4s
Validation | Loss:     0.7192 | Accuracy:  78.0355% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1971 | Accuracy:  95.5501% | Elapsed:     4s
Validation | Loss:     0.7195 | Accuracy:  78.3083% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1961 | Accuracy:  95.6325% | Elapsed:     4s
```

```
Validation | Loss:     0.7165 | Accuracy:  78.4447% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1950 | Accuracy:  95.5913% | Elapsed:     4s
Validation | Loss:     0.7124 | Accuracy:  78.1719% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1939 | Accuracy:  95.7149% | Elapsed:     4s
Validation | Loss:     0.7136 | Accuracy:  78.1719% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1922 | Accuracy:  95.7149% | Elapsed:     4s
Validation | Loss:     0.7168 | Accuracy:  78.0355% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1904 | Accuracy:  95.7149% | Elapsed:     4s
Validation | Loss:     0.7158 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1885 | Accuracy:  95.9209% | Elapsed:     4s
Validation | Loss:     0.7203 | Accuracy:  78.3083% | Elapsed:     1s
Epoch 00063: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1857 | Accuracy:  95.9621% | Elapsed:     4s
Validation | Loss:     0.7201 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1855 | Accuracy:  95.9621% | Elapsed:     4s
Validation | Loss:     0.7200 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1853 | Accuracy:  96.0033% | Elapsed:     4s
Validation | Loss:     0.7199 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1851 | Accuracy:  96.0033% | Elapsed:     4s
Validation | Loss:     0.7200 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1849 | Accuracy:  96.0033% | Elapsed:     4s
Validation | Loss:     0.7196 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1848 | Accuracy:  96.0445% | Elapsed:     4s
Validation | Loss:     0.7201 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1846 | Accuracy:  96.0033% | Elapsed:     4s
Validation | Loss:     0.7202 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1845 | Accuracy:  96.0857% | Elapsed:     4s
Validation | Loss:     0.7201 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1843 | Accuracy:  96.0445% | Elapsed:     4s
Validation | Loss:     0.7203 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1841 | Accuracy:  96.0857% | Elapsed:     4s
Validation | Loss:     0.7207 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1840 | Accuracy:  96.0445% | Elapsed:     4s
Validation | Loss:     0.7204 | Accuracy:  78.3083% | Elapsed:     1s
Epoch 00074: reducing learning rate of group 0 to 1.0000e-07.
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1837 | Accuracy:  96.0445% | Elapsed:     4s
Validation | Loss:     0.7205 | Accuracy:  78.3083% | Elapsed:     1s
================================================================================
Training complete in 5m 23s
Best model accuracy:  78.44%
================================================================================
|
|
|
|
|

================================================================================
Hidden Size = 256
RNN Layers = 1
L2 Regularization Weight = 0.001
--------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 256, batch_first=True)
  (fc): Linear(in_features=256, out_features=10, bias=False)
)
```

```
------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9619 | Accuracy:  26.7408% | Elapsed:     4s
Validation | Loss:     1.9199 | Accuracy:  32.7422% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5916 | Accuracy:  43.0985% | Elapsed:     3s
Validation | Loss:     1.6085 | Accuracy:  46.3847% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3709 | Accuracy:  51.9984% | Elapsed:     3s
Validation | Loss:     1.4524 | Accuracy:  52.3874% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2180 | Accuracy:  58.7557% | Elapsed:     4s
Validation | Loss:     1.4868 | Accuracy:  48.2947% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1056 | Accuracy:  64.3181% | Elapsed:     4s
Validation | Loss:     1.2130 | Accuracy:  58.9359% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.0086 | Accuracy:  67.6555% | Elapsed:     4s
Validation | Loss:     1.1391 | Accuracy:  64.6658% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.9257 | Accuracy:  70.9106% | Elapsed:     4s
Validation | Loss:     1.0897 | Accuracy:  62.6194% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.8838 | Accuracy:  73.1356% | Elapsed:     4s
Validation | Loss:     1.2094 | Accuracy:  53.8881% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.8677 | Accuracy:  74.4541% | Elapsed:     4s
Validation | Loss:     1.2644 | Accuracy:  57.8445% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8671 | Accuracy:  73.8360% | Elapsed:     4s
Validation | Loss:     1.0716 | Accuracy:  65.2115% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.7963 | Accuracy:  76.2258% | Elapsed:     4s
Validation | Loss:     1.1826 | Accuracy:  58.6630% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.7569 | Accuracy:  77.9563% | Elapsed:     4s
Validation | Loss:     0.9492 | Accuracy:  70.1228% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.7222 | Accuracy:  79.0276% | Elapsed:     3s
Validation | Loss:     0.9645 | Accuracy:  68.8950% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.6857 | Accuracy:  79.9753% | Elapsed:     4s
Validation | Loss:     0.9197 | Accuracy:  70.1228% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.6478 | Accuracy:  81.8294% | Elapsed:     4s
Validation | Loss:     1.0063 | Accuracy:  66.1664% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.6372 | Accuracy:  81.5410% | Elapsed:     4s
Validation | Loss:     0.8959 | Accuracy:  69.8499% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.5949 | Accuracy:  82.6947% | Elapsed:     4s
Validation | Loss:     0.8509 | Accuracy:  71.2142% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.6025 | Accuracy:  82.6535% | Elapsed:     4s
Validation | Loss:     0.8242 | Accuracy:  73.8063% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.5517 | Accuracy:  84.2604% | Elapsed:     4s
Validation | Loss:     0.7948 | Accuracy:  74.6248% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.5604 | Accuracy:  83.8072% | Elapsed:     4s
Validation | Loss:     0.8245 | Accuracy:  72.0327% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.5434 | Accuracy:  85.2081% | Elapsed:     4s
Validation | Loss:     0.7363 | Accuracy:  75.7162% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.5508 | Accuracy:  83.8484% | Elapsed:     4s
Validation | Loss:     0.8012 | Accuracy:  74.7613% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.5454 | Accuracy:  84.4252% | Elapsed:     4s
```

```
Validation | Loss:     0.8917 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.5548 | Accuracy:  85.0433% | Elapsed:     4s
Validation | Loss:     0.8893 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5089 | Accuracy:  86.8150% | Elapsed:     4s
Validation | Loss:     0.7821 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.5100 | Accuracy:  85.2905% | Elapsed:     4s
Validation | Loss:     0.8574 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.4741 | Accuracy:  86.3618% | Elapsed:     4s
Validation | Loss:     0.9751 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.4964 | Accuracy:  85.3317% | Elapsed:     4s
Validation | Loss:     0.8082 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.4886 | Accuracy:  86.5266% | Elapsed:     4s
Validation | Loss:     0.7528 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.5276 | Accuracy:  84.9197% | Elapsed:     4s
Validation | Loss:     0.9541 | Accuracy:  68.7585% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.5340 | Accuracy:  85.5789% | Elapsed:     4s
Validation | Loss:     0.8418 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.5242 | Accuracy:  86.0321% | Elapsed:     4s
Validation | Loss:     0.9958 | Accuracy:  65.3479% | Elapsed:     1s
Epoch 00032: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.4221 | Accuracy:  88.9988% | Elapsed:     3s
Validation | Loss:     0.8186 | Accuracy:  75.0341% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.3964 | Accuracy:  89.6168% | Elapsed:     4s
Validation | Loss:     0.7907 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.3760 | Accuracy:  90.8117% | Elapsed:     4s
Validation | Loss:     0.7934 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.3677 | Accuracy:  90.9353% | Elapsed:     4s
Validation | Loss:     0.7630 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3502 | Accuracy:  91.4710% | Elapsed:     4s
Validation | Loss:     0.7620 | Accuracy:  75.3070% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3425 | Accuracy:  91.5946% | Elapsed:     4s
Validation | Loss:     0.7883 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3279 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     0.7285 | Accuracy:  75.0341% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.3157 | Accuracy:  92.5834% | Elapsed:     4s
Validation | Loss:     0.7596 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3112 | Accuracy:  92.4186% | Elapsed:     4s
Validation | Loss:     0.7053 | Accuracy:  76.1255% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.3048 | Accuracy:  92.7895% | Elapsed:     4s
Validation | Loss:     0.7140 | Accuracy:  75.3070% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3015 | Accuracy:  92.9131% | Elapsed:     4s
Validation | Loss:     0.7053 | Accuracy:  77.4898% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2957 | Accuracy:  93.2427% | Elapsed:     4s
Validation | Loss:     0.7441 | Accuracy:  75.1705% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2907 | Accuracy:  93.4487% | Elapsed:     4s
Validation | Loss:     0.7964 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 46/75
Training   | Loss:     0.2880 | Accuracy:  92.9955% | Elapsed:     4s
Validation | Loss:     0.7460 | Accuracy:  75.3070% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2824 | Accuracy:  93.8195% | Elapsed:     4s
Validation | Loss:     0.7737 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2765 | Accuracy:  93.8607% | Elapsed:     4s
Validation | Loss:     0.8024 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2687 | Accuracy:  94.0667% | Elapsed:     4s
Validation | Loss:     0.6923 | Accuracy:  77.6262% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2663 | Accuracy:  93.7783% | Elapsed:     4s
Validation | Loss:     0.7184 | Accuracy:  77.7626% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2618 | Accuracy:  93.6547% | Elapsed:     4s
Validation | Loss:     0.7348 | Accuracy:  75.5798% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2579 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.7038 | Accuracy:  76.9441% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2530 | Accuracy:  94.7260% | Elapsed:     4s
Validation | Loss:     0.7357 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2487 | Accuracy:  94.8496% | Elapsed:     4s
Validation | Loss:     0.7305 | Accuracy:  76.3984% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.2443 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.7025 | Accuracy:  77.6262% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.2435 | Accuracy:  95.0556% | Elapsed:     4s
Validation | Loss:     0.6880 | Accuracy:  78.0355% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.2384 | Accuracy:  95.0144% | Elapsed:     4s
Validation | Loss:     0.7271 | Accuracy:  76.2619% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.2348 | Accuracy:  95.4677% | Elapsed:     4s
Validation | Loss:     0.7377 | Accuracy:  75.9891% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.2278 | Accuracy:  94.9320% | Elapsed:     4s
Validation | Loss:     0.6937 | Accuracy:  78.3083% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.2240 | Accuracy:  95.1792% | Elapsed:     4s
Validation | Loss:     0.7347 | Accuracy:  75.3070% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.2237 | Accuracy:  95.0144% | Elapsed:     4s
Validation | Loss:     0.6899 | Accuracy:  78.0355% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2221 | Accuracy:  95.1380% | Elapsed:     4s
Validation | Loss:     0.7412 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2147 | Accuracy:  95.4265% | Elapsed:     4s
Validation | Loss:     0.6737 | Accuracy:  79.6726% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.2146 | Accuracy:  95.5089% | Elapsed:     4s
Validation | Loss:     0.7011 | Accuracy:  77.3533% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2098 | Accuracy:  95.3852% | Elapsed:     4s
Validation | Loss:     0.6707 | Accuracy:  79.5362% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2070 | Accuracy:  95.7973% | Elapsed:     4s
Validation | Loss:     0.7233 | Accuracy:  77.0805% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.2014 | Accuracy:  95.6325% | Elapsed:     4s
Validation | Loss:     0.7093 | Accuracy:  76.2619% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.2067 | Accuracy:  95.6737% | Elapsed:     4s
Validation | Loss:     0.6775 | Accuracy:  77.8990% | Elapsed:     1s
```

```
------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1982 | Accuracy:  95.7973% | Elapsed:     4s
Validation | Loss:     0.7029 | Accuracy:  75.5798% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.2008 | Accuracy:  95.7973% | Elapsed:     4s
Validation | Loss:     0.6806 | Accuracy:  77.7626% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1933 | Accuracy:  96.0033% | Elapsed:     4s
Validation | Loss:     0.7129 | Accuracy:  76.5348% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1933 | Accuracy:  96.1681% | Elapsed:     4s
Validation | Loss:     0.6793 | Accuracy:  77.0805% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1878 | Accuracy:  96.2505% | Elapsed:     4s
Validation | Loss:     0.6928 | Accuracy:  77.7626% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1874 | Accuracy:  96.2093% | Elapsed:     4s
Validation | Loss:     0.6900 | Accuracy:  76.2619% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1839 | Accuracy:  96.2917% | Elapsed:     4s
Validation | Loss:     0.6883 | Accuracy:  77.8990% | Elapsed:     1s
==============================================================================
Training complete in 5m 28s
Best model accuracy:  79.67%
==============================================================================
|
|
|
|
|

==============================================================================
Hidden Size = 256
RNN Layers = 1
L2 Regularization Weight = 0.01
------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 256, batch_first=True)
  (fc): Linear(in_features=256, out_features=10, bias=False)
)
------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9347 | Accuracy:  28.7186% | Elapsed:     4s
Validation | Loss:     1.9070 | Accuracy:  30.4229% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6938 | Accuracy:  37.7833% | Elapsed:     4s
Validation | Loss:     1.7187 | Accuracy:  37.5171% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.5406 | Accuracy:  44.4170% | Elapsed:     4s
Validation | Loss:     1.8135 | Accuracy:  39.6999% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.4925 | Accuracy:  48.2901% | Elapsed:     4s
Validation | Loss:     1.6522 | Accuracy:  44.8840% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.4378 | Accuracy:  49.8970% | Elapsed:     4s
Validation | Loss:     1.6160 | Accuracy:  44.3383% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.3856 | Accuracy:  52.1220% | Elapsed:     4s
Validation | Loss:     1.5912 | Accuracy:  45.0205% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.3387 | Accuracy:  53.5641% | Elapsed:     4s
Validation | Loss:     1.5638 | Accuracy:  45.8390% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.3096 | Accuracy:  56.0363% | Elapsed:     4s
Validation | Loss:     1.4779 | Accuracy:  49.3861% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.2657 | Accuracy:  57.7668% | Elapsed:     4s
Validation | Loss:     1.5662 | Accuracy:  41.3370% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.2449 | Accuracy:  57.9728% | Elapsed:     4s
Validation | Loss:     1.5849 | Accuracy:  43.2469% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.2166 | Accuracy:  60.0330% | Elapsed:     4s
```

```
Validation | Loss:     1.4304 | Accuracy:  52.3874% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.2065 | Accuracy:  62.2579% | Elapsed:     4s
Validation | Loss:     1.4300 | Accuracy:  52.2510% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.1729 | Accuracy:  61.8047% | Elapsed:     4s
Validation | Loss:     1.3718 | Accuracy:  51.9782% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.1563 | Accuracy:  63.6176% | Elapsed:     4s
Validation | Loss:     1.3989 | Accuracy:  48.7040% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.1663 | Accuracy:  63.6176% | Elapsed:     4s
Validation | Loss:     1.3837 | Accuracy:  57.2988% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.1296 | Accuracy:  65.3070% | Elapsed:     4s
Validation | Loss:     1.3681 | Accuracy:  56.4802% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.1101 | Accuracy:  65.3482% | Elapsed:     4s
Validation | Loss:     1.3888 | Accuracy:  54.9795% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.0960 | Accuracy:  67.4907% | Elapsed:     4s
Validation | Loss:     1.3322 | Accuracy:  51.7053% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.0850 | Accuracy:  66.0486% | Elapsed:     4s
Validation | Loss:     1.3478 | Accuracy:  52.6603% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.0510 | Accuracy:  67.5731% | Elapsed:     4s
Validation | Loss:     1.2008 | Accuracy:  61.8008% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.0280 | Accuracy:  68.3972% | Elapsed:     4s
Validation | Loss:     1.2186 | Accuracy:  58.7995% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.0437 | Accuracy:  68.6444% | Elapsed:     4s
Validation | Loss:     1.3065 | Accuracy:  58.1173% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.0154 | Accuracy:  70.7046% | Elapsed:     4s
Validation | Loss:     1.3127 | Accuracy:  60.9823% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.0235 | Accuracy:  70.0865% | Elapsed:     4s
Validation | Loss:     1.3800 | Accuracy:  53.2060% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.0093 | Accuracy:  70.9930% | Elapsed:     4s
Validation | Loss:     1.2117 | Accuracy:  61.6644% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.9833 | Accuracy:  71.5286% | Elapsed:     4s
Validation | Loss:     1.3570 | Accuracy:  56.6166% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.9983 | Accuracy:  71.0342% | Elapsed:     4s
Validation | Loss:     1.2768 | Accuracy:  58.3902% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.9866 | Accuracy:  72.1055% | Elapsed:     4s
Validation | Loss:     1.2635 | Accuracy:  61.2551% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.9945 | Accuracy:  70.0041% | Elapsed:     4s
Validation | Loss:     1.2258 | Accuracy:  60.8458% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.9726 | Accuracy:  72.5587% | Elapsed:     4s
Validation | Loss:     1.3157 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.9806 | Accuracy:  71.4050% | Elapsed:     4s
Validation | Loss:     1.1642 | Accuracy:  62.3465% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.9540 | Accuracy:  71.8995% | Elapsed:     4s
Validation | Loss:     1.2138 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.9624 | Accuracy:  71.4050% | Elapsed:     4s
Validation | Loss:     1.1446 | Accuracy:  67.8035% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
```

```
Training   | Loss:     0.9481 | Accuracy:  73.2180% | Elapsed:     4s
Validation | Loss:     1.2010 | Accuracy:  61.6644% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.9637 | Accuracy:  72.5587% | Elapsed:     4s
Validation | Loss:     1.2515 | Accuracy:  60.7094% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.9508 | Accuracy:  73.5476% | Elapsed:     4s
Validation | Loss:     1.1444 | Accuracy:  65.3479% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.9497 | Accuracy:  74.7425% | Elapsed:     4s
Validation | Loss:     1.1645 | Accuracy:  64.6658% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.9779 | Accuracy:  72.1467% | Elapsed:     4s
Validation | Loss:     1.2404 | Accuracy:  62.7558% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.9486 | Accuracy:  72.3939% | Elapsed:     4s
Validation | Loss:     1.1774 | Accuracy:  64.6658% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.9077 | Accuracy:  75.2369% | Elapsed:     4s
Validation | Loss:     1.2472 | Accuracy:  57.2988% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.9115 | Accuracy:  74.3717% | Elapsed:     4s
Validation | Loss:     1.1303 | Accuracy:  66.0300% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.8914 | Accuracy:  75.7314% | Elapsed:     4s
Validation | Loss:     1.1594 | Accuracy:  63.3015% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.9034 | Accuracy:  74.1244% | Elapsed:     4s
Validation | Loss:     1.1490 | Accuracy:  63.9836% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.8914 | Accuracy:  76.0198% | Elapsed:     4s
Validation | Loss:     1.2394 | Accuracy:  59.3452% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9118 | Accuracy:  75.0721% | Elapsed:     4s
Validation | Loss:     1.1133 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.8910 | Accuracy:  76.5554% | Elapsed:     4s
Validation | Loss:     1.1192 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.8889 | Accuracy:  75.6489% | Elapsed:     4s
Validation | Loss:     1.2078 | Accuracy:  61.2551% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.8829 | Accuracy:  75.4429% | Elapsed:     4s
Validation | Loss:     1.1289 | Accuracy:  65.8936% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.8836 | Accuracy:  75.4841% | Elapsed:     4s
Validation | Loss:     1.1510 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.8724 | Accuracy:  77.3383% | Elapsed:     4s
Validation | Loss:     1.2003 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.9112 | Accuracy:  74.8661% | Elapsed:     4s
Validation | Loss:     1.1587 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.9493 | Accuracy:  72.6823% | Elapsed:     4s
Validation | Loss:     1.2022 | Accuracy:  61.5280% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.9195 | Accuracy:  75.1545% | Elapsed:     4s
Validation | Loss:     1.0892 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.9022 | Accuracy:  75.3605% | Elapsed:     4s
Validation | Loss:     1.1982 | Accuracy:  61.8008% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.9245 | Accuracy:  75.3605% | Elapsed:     4s
Validation | Loss:     1.1361 | Accuracy:  65.3479% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.9701 | Accuracy:  71.6934% | Elapsed:     4s
Validation | Loss:     1.2256 | Accuracy:  62.6194% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 57/75
Training   | Loss:     0.9483 | Accuracy:  72.6823% | Elapsed:     4s
Validation | Loss:     1.1520 | Accuracy:  65.7572% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.9098 | Accuracy:  73.5888% | Elapsed:     4s
Validation | Loss:     1.0776 | Accuracy:  69.0314% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.8889 | Accuracy:  75.5253% | Elapsed:     4s
Validation | Loss:     1.1497 | Accuracy:  64.3929% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.8597 | Accuracy:  77.6267% | Elapsed:     4s
Validation | Loss:     1.1861 | Accuracy:  62.4829% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.8705 | Accuracy:  76.3082% | Elapsed:     4s
Validation | Loss:     1.1362 | Accuracy:  64.9386% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.8710 | Accuracy:  77.1323% | Elapsed:     4s
Validation | Loss:     1.2328 | Accuracy:  60.5730% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.9022 | Accuracy:  75.5665% | Elapsed:     4s
Validation | Loss:     1.1601 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.9564 | Accuracy:  72.4763% | Elapsed:     4s
Validation | Loss:     1.2608 | Accuracy:  60.3001% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.9444 | Accuracy:  73.5476% | Elapsed:     4s
Validation | Loss:     1.2381 | Accuracy:  64.5293% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.9529 | Accuracy:  73.3416% | Elapsed:     4s
Validation | Loss:     1.1495 | Accuracy:  65.4843% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.9214 | Accuracy:  74.4541% | Elapsed:     4s
Validation | Loss:     1.1980 | Accuracy:  61.8008% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.9142 | Accuracy:  75.5253% | Elapsed:     4s
Validation | Loss:     1.2932 | Accuracy:  60.5730% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.9166 | Accuracy:  74.9485% | Elapsed:     4s
Validation | Loss:     1.1441 | Accuracy:  66.0300% | Elapsed:     1s
Epoch 00069: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.8372 | Accuracy:  78.3684% | Elapsed:     4s
Validation | Loss:     1.1066 | Accuracy:  67.8035% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.8174 | Accuracy:  79.6044% | Elapsed:     4s
Validation | Loss:     1.1038 | Accuracy:  68.3492% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.8014 | Accuracy:  79.9753% | Elapsed:     4s
Validation | Loss:     1.0871 | Accuracy:  67.8035% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.7888 | Accuracy:  80.6345% | Elapsed:     4s
Validation | Loss:     1.0725 | Accuracy:  68.4857% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.7781 | Accuracy:  81.0054% | Elapsed:     4s
Validation | Loss:     1.0753 | Accuracy:  68.4857% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.7714 | Accuracy:  81.1290% | Elapsed:     4s
Validation | Loss:     1.0439 | Accuracy:  70.2592% | Elapsed:     1s
===========================================================================
Training complete in 5m 33s
Best model accuracy:  70.26%
===========================================================================
|
|
|
|
|

===========================================================================
Hidden Size = 256
RNN Layers = 2
L2 Regularization Weight = 0.0001
---------------------------------------------------------------------------
```

```
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 256, num_layers=2, batch_first=True)
  (fc): Linear(in_features=256, out_features=10, bias=False)
)
---------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9445 | Accuracy:  25.1751% | Elapsed:     4s
Validation | Loss:     1.8443 | Accuracy:  32.4693% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5983 | Accuracy:  39.2254% | Elapsed:     4s
Validation | Loss:     1.6583 | Accuracy:  37.2442% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.5545 | Accuracy:  41.6976% | Elapsed:     4s
Validation | Loss:     1.5350 | Accuracy:  43.9291% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.3827 | Accuracy:  47.5072% | Elapsed:     4s
Validation | Loss:     1.8149 | Accuracy:  36.2892% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.3335 | Accuracy:  48.1665% | Elapsed:     4s
Validation | Loss:     1.4791 | Accuracy:  46.7940% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.2239 | Accuracy:  52.8224% | Elapsed:     4s
Validation | Loss:     1.6558 | Accuracy:  38.6085% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.2454 | Accuracy:  52.7400% | Elapsed:     4s
Validation | Loss:     1.3814 | Accuracy:  51.2960% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.1386 | Accuracy:  54.6354% | Elapsed:     4s
Validation | Loss:     1.3577 | Accuracy:  47.4761% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.0948 | Accuracy:  58.9205% | Elapsed:     4s
Validation | Loss:     1.2899 | Accuracy:  50.3411% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.1097 | Accuracy:  58.3848% | Elapsed:     4s
Validation | Loss:     1.1751 | Accuracy:  57.4352% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.0598 | Accuracy:  60.4862% | Elapsed:     4s
Validation | Loss:     1.2192 | Accuracy:  56.8895% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.9408 | Accuracy:  64.4005% | Elapsed:     4s
Validation | Loss:     1.2484 | Accuracy:  55.7981% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.8987 | Accuracy:  66.8727% | Elapsed:     4s
Validation | Loss:     1.4620 | Accuracy:  49.5225% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.9140 | Accuracy:  65.8426% | Elapsed:     4s
Validation | Loss:     1.3395 | Accuracy:  54.7067% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.8416 | Accuracy:  70.6222% | Elapsed:     4s
Validation | Loss:     1.1407 | Accuracy:  62.8922% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.8178 | Accuracy:  70.9518% | Elapsed:     4s
Validation | Loss:     0.9815 | Accuracy:  64.9386% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.8698 | Accuracy:  68.8092% | Elapsed:     4s
Validation | Loss:     1.0694 | Accuracy:  65.0750% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.7137 | Accuracy:  74.6601% | Elapsed:     4s
Validation | Loss:     1.0516 | Accuracy:  69.3042% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.6995 | Accuracy:  76.0198% | Elapsed:     4s
Validation | Loss:     1.1800 | Accuracy:  64.8022% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.6574 | Accuracy:  78.5744% | Elapsed:     4s
Validation | Loss:     0.9188 | Accuracy:  69.3042% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.7761 | Accuracy:  73.3004% | Elapsed:     4s
Validation | Loss:     1.0590 | Accuracy:  64.9386% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
```

```
Training   | Loss:     0.7302 | Accuracy:  74.1244% | Elapsed:     4s
Validation | Loss:     1.0013 | Accuracy:  64.1201% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6492 | Accuracy:  77.6267% | Elapsed:     4s
Validation | Loss:     0.9913 | Accuracy:  66.9850% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.6016 | Accuracy:  79.1512% | Elapsed:     4s
Validation | Loss:     1.2620 | Accuracy:  63.1651% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5745 | Accuracy:  79.4396% | Elapsed:     4s
Validation | Loss:     1.2847 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.5840 | Accuracy:  79.7281% | Elapsed:     4s
Validation | Loss:     0.8622 | Accuracy:  71.3506% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.7017 | Accuracy:  76.5142% | Elapsed:     4s
Validation | Loss:     1.1330 | Accuracy:  63.0286% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.5844 | Accuracy:  80.0989% | Elapsed:     4s
Validation | Loss:     1.1008 | Accuracy:  64.3929% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.5725 | Accuracy:  80.5933% | Elapsed:     4s
Validation | Loss:     1.1940 | Accuracy:  67.5307% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.6745 | Accuracy:  76.1022% | Elapsed:     4s
Validation | Loss:     1.0457 | Accuracy:  68.3492% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.5786 | Accuracy:  80.3873% | Elapsed:     4s
Validation | Loss:     1.0913 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.4832 | Accuracy:  84.0132% | Elapsed:     4s
Validation | Loss:     1.1334 | Accuracy:  66.3029% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.4759 | Accuracy:  83.4363% | Elapsed:     4s
Validation | Loss:     0.8580 | Accuracy:  71.4870% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.4707 | Accuracy:  84.3016% | Elapsed:     4s
Validation | Loss:     1.2337 | Accuracy:  66.8486% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.5029 | Accuracy:  82.4063% | Elapsed:     4s
Validation | Loss:     1.0934 | Accuracy:  67.6671% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.4405 | Accuracy:  84.9197% | Elapsed:     4s
Validation | Loss:     1.1431 | Accuracy:  65.6207% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.6783 | Accuracy:  76.4730% | Elapsed:     3s
Validation | Loss:     0.9370 | Accuracy:  73.2606% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.4275 | Accuracy:  85.3729% | Elapsed:     4s
Validation | Loss:     1.1447 | Accuracy:  69.0314% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.4043 | Accuracy:  86.3206% | Elapsed:     4s
Validation | Loss:     1.2440 | Accuracy:  64.6658% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.5068 | Accuracy:  82.9831% | Elapsed:     4s
Validation | Loss:     0.8850 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.4263 | Accuracy:  85.4141% | Elapsed:     4s
Validation | Loss:     1.0673 | Accuracy:  69.9864% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.4014 | Accuracy:  86.1970% | Elapsed:     4s
Validation | Loss:     1.0977 | Accuracy:  72.3056% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3514 | Accuracy:  87.7627% | Elapsed:     4s
Validation | Loss:     1.0012 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.3860 | Accuracy:  86.3618% | Elapsed:     4s
Validation | Loss:     1.3338 | Accuracy:  64.9386% | Elapsed:     1s
Epoch 00044: reducing learning rate of group 0 to 1.0000e-04.
```

```
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2955 | Accuracy:  90.8117% | Elapsed:     4s
Validation | Loss:     1.0811 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2319 | Accuracy:  93.1603% | Elapsed:     4s
Validation | Loss:     1.0823 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2129 | Accuracy:  93.6135% | Elapsed:     4s
Validation | Loss:     1.0788 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2000 | Accuracy:  94.1492% | Elapsed:     4s
Validation | Loss:     1.1693 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.1908 | Accuracy:  94.4376% | Elapsed:     4s
Validation | Loss:     1.1463 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.1816 | Accuracy:  94.6024% | Elapsed:     4s
Validation | Loss:     1.0693 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.1811 | Accuracy:  94.3964% | Elapsed:     4s
Validation | Loss:     1.2247 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.1664 | Accuracy:  95.1792% | Elapsed:     4s
Validation | Loss:     1.2018 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.1617 | Accuracy:  95.3852% | Elapsed:     4s
Validation | Loss:     1.2006 | Accuracy:  72.4420% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.1530 | Accuracy:  95.3440% | Elapsed:     4s
Validation | Loss:     1.2967 | Accuracy:  71.6235% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1443 | Accuracy:  95.7149% | Elapsed:     4s
Validation | Loss:     1.2218 | Accuracy:  72.4420% | Elapsed:     1s
Epoch 00055: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1309 | Accuracy:  96.5389% | Elapsed:     4s
Validation | Loss:     1.2725 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1274 | Accuracy:  96.6625% | Elapsed:     4s
Validation | Loss:     1.2889 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1258 | Accuracy:  96.7450% | Elapsed:     4s
Validation | Loss:     1.2960 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1244 | Accuracy:  96.8274% | Elapsed:     4s
Validation | Loss:     1.3067 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1230 | Accuracy:  96.7862% | Elapsed:     4s
Validation | Loss:     1.3008 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1219 | Accuracy:  96.7862% | Elapsed:     4s
Validation | Loss:     1.3128 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1206 | Accuracy:  96.7037% | Elapsed:     4s
Validation | Loss:     1.3109 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1195 | Accuracy:  96.7450% | Elapsed:     4s
Validation | Loss:     1.3144 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1181 | Accuracy:  96.8274% | Elapsed:     4s
Validation | Loss:     1.3317 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1167 | Accuracy:  96.9098% | Elapsed:     4s
Validation | Loss:     1.3420 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1154 | Accuracy:  96.9098% | Elapsed:     4s
Validation | Loss:     1.3319 | Accuracy:  72.1692% | Elapsed:     1s
Epoch 00066: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
```

```
Epoch 67/75
Training   | Loss:     0.1130 | Accuracy:  97.0334% | Elapsed:     4s
Validation | Loss:     1.3336 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1128 | Accuracy:  97.0746% | Elapsed:     4s
Validation | Loss:     1.3353 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1127 | Accuracy:  97.0334% | Elapsed:     4s
Validation | Loss:     1.3366 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1125 | Accuracy:  97.0746% | Elapsed:     4s
Validation | Loss:     1.3373 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1124 | Accuracy:  97.0746% | Elapsed:     4s
Validation | Loss:     1.3377 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1122 | Accuracy:  97.0746% | Elapsed:     4s
Validation | Loss:     1.3383 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1121 | Accuracy:  97.1158% | Elapsed:     4s
Validation | Loss:     1.3384 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1119 | Accuracy:  97.1158% | Elapsed:     4s
Validation | Loss:     1.3396 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1118 | Accuracy:  97.1158% | Elapsed:     4s
Validation | Loss:     1.3395 | Accuracy:  72.0327% | Elapsed:     1s
===========================================================================
Training complete in 5m 26s
Best model accuracy:  73.26%
===========================================================================
|
|
|
|
|

===========================================================================
Hidden Size = 256
RNN Layers = 2
L2 Regularization Weight = 0.001
---------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 256, num_layers=2, batch_first=True)
  (fc): Linear(in_features=256, out_features=10, bias=False)
)
---------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.8701 | Accuracy:  28.4714% | Elapsed:     4s
Validation | Loss:     1.7896 | Accuracy:  29.4679% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5315 | Accuracy:  41.4091% | Elapsed:     4s
Validation | Loss:     1.6713 | Accuracy:  37.1078% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.5080 | Accuracy:  42.0272% | Elapsed:     4s
Validation | Loss:     1.5861 | Accuracy:  39.1542% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.4182 | Accuracy:  46.0239% | Elapsed:     4s
Validation | Loss:     1.6364 | Accuracy:  39.5634% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.2595 | Accuracy:  51.1743% | Elapsed:     4s
Validation | Loss:     1.3672 | Accuracy:  50.8868% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.1794 | Accuracy:  55.7890% | Elapsed:     4s
Validation | Loss:     1.4501 | Accuracy:  50.7503% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.1282 | Accuracy:  58.4260% | Elapsed:     4s
Validation | Loss:     1.7183 | Accuracy:  44.7476% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.1952 | Accuracy:  55.7890% | Elapsed:     4s
Validation | Loss:     1.3288 | Accuracy:  52.1146% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.0290 | Accuracy:  62.9172% | Elapsed:     4s
Validation | Loss:     1.1881 | Accuracy:  51.5689% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.9891 | Accuracy:  65.5130% | Elapsed:     4s
Validation | Loss:     1.3570 | Accuracy:  53.4789% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.9636 | Accuracy:  64.8949% | Elapsed:     3s
Validation | Loss:     1.1978 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.8713 | Accuracy:  69.6333% | Elapsed:     4s
Validation | Loss:     1.2049 | Accuracy:  58.7995% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.8210 | Accuracy:  71.1578% | Elapsed:     4s
Validation | Loss:     1.2615 | Accuracy:  60.0273% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.8955 | Accuracy:  68.2324% | Elapsed:     4s
Validation | Loss:     1.0896 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.8599 | Accuracy:  69.1389% | Elapsed:     4s
Validation | Loss:     1.1811 | Accuracy:  64.9386% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.9194 | Accuracy:  68.9328% | Elapsed:     4s
Validation | Loss:     2.0268 | Accuracy:  26.3302% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.5562 | Accuracy:  41.0383% | Elapsed:     4s
Validation | Loss:     1.3839 | Accuracy:  44.6112% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.2503 | Accuracy:  53.4817% | Elapsed:     4s
Validation | Loss:     1.3277 | Accuracy:  55.1160% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.0899 | Accuracy:  60.5274% | Elapsed:     4s
Validation | Loss:     1.2092 | Accuracy:  55.1160% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.0564 | Accuracy:  62.7112% | Elapsed:     4s
Validation | Loss:     1.2288 | Accuracy:  60.3001% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.5018 | Accuracy:  41.8212% | Elapsed:     4s
Validation | Loss:     1.7960 | Accuracy:  44.8840% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.2014 | Accuracy:  55.4182% | Elapsed:     4s
Validation | Loss:     1.2855 | Accuracy:  53.8881% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.1196 | Accuracy:  60.4862% | Elapsed:     4s
Validation | Loss:     1.4176 | Accuracy:  51.5689% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.0146 | Accuracy:  64.7301% | Elapsed:     4s
Validation | Loss:     1.1182 | Accuracy:  61.2551% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.8922 | Accuracy:  70.0041% | Elapsed:     3s
Validation | Loss:     1.2809 | Accuracy:  61.5280% | Elapsed:     1s
Epoch 00025: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.6846 | Accuracy:  78.8216% | Elapsed:     4s
Validation | Loss:     1.2597 | Accuracy:  59.7544% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.6456 | Accuracy:  79.8517% | Elapsed:     4s
Validation | Loss:     1.1313 | Accuracy:  63.7108% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.6180 | Accuracy:  81.2114% | Elapsed:     4s
Validation | Loss:     1.1270 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.5944 | Accuracy:  81.4586% | Elapsed:     4s
Validation | Loss:     1.2973 | Accuracy:  61.8008% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.5751 | Accuracy:  81.9942% | Elapsed:     4s
Validation | Loss:     1.1502 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.5591 | Accuracy:  82.4475% | Elapsed:     4s
Validation | Loss:     1.0960 | Accuracy:  67.1214% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
```

```
Training   | Loss:     0.5444 | Accuracy:  82.9007% | Elapsed:     4s
Validation | Loss:     1.1502 | Accuracy:  66.9850% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.5280 | Accuracy:  83.7660% | Elapsed:     4s
Validation | Loss:     1.1444 | Accuracy:  67.6671% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.5157 | Accuracy:  83.5187% | Elapsed:     3s
Validation | Loss:     1.0763 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.4983 | Accuracy:  83.9720% | Elapsed:     4s
Validation | Loss:     1.1478 | Accuracy:  66.9850% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.4899 | Accuracy:  84.5900% | Elapsed:     4s
Validation | Loss:     1.2142 | Accuracy:  65.6207% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.4781 | Accuracy:  85.1257% | Elapsed:     4s
Validation | Loss:     1.1684 | Accuracy:  66.0300% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.4699 | Accuracy:  85.0021% | Elapsed:     4s
Validation | Loss:     1.2476 | Accuracy:  66.7121% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.4540 | Accuracy:  85.5789% | Elapsed:     4s
Validation | Loss:     1.2927 | Accuracy:  66.4393% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.4356 | Accuracy:  86.5678% | Elapsed:     4s
Validation | Loss:     1.1802 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.4300 | Accuracy:  86.7326% | Elapsed:     3s
Validation | Loss:     1.2376 | Accuracy:  67.8035% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.4152 | Accuracy:  86.8562% | Elapsed:     4s
Validation | Loss:     1.2553 | Accuracy:  68.3492% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.4111 | Accuracy:  86.7326% | Elapsed:     3s
Validation | Loss:     1.3802 | Accuracy:  66.1664% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.4054 | Accuracy:  87.3918% | Elapsed:     4s
Validation | Loss:     1.3318 | Accuracy:  68.3492% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.4138 | Accuracy:  86.6502% | Elapsed:     4s
Validation | Loss:     1.2403 | Accuracy:  65.3479% | Elapsed:     1s
Epoch 00045: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.3662 | Accuracy:  88.7515% | Elapsed:     4s
Validation | Loss:     1.1862 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.3518 | Accuracy:  89.5756% | Elapsed:     4s
Validation | Loss:     1.2113 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.3477 | Accuracy:  89.6992% | Elapsed:     4s
Validation | Loss:     1.2137 | Accuracy:  68.6221% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.3434 | Accuracy:  90.0700% | Elapsed:     4s
Validation | Loss:     1.2277 | Accuracy:  68.6221% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.3389 | Accuracy:  89.9876% | Elapsed:     4s
Validation | Loss:     1.2338 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.3368 | Accuracy:  89.9464% | Elapsed:     4s
Validation | Loss:     1.2366 | Accuracy:  69.3042% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.3295 | Accuracy:  90.4409% | Elapsed:     4s
Validation | Loss:     1.2485 | Accuracy:  69.1678% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.3285 | Accuracy:  90.2349% | Elapsed:     4s
Validation | Loss:     1.2512 | Accuracy:  68.7585% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.3239 | Accuracy:  90.6469% | Elapsed:     4s
Validation | Loss:     1.2490 | Accuracy:  69.3042% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.3183 | Accuracy:  90.8117% | Elapsed:     4s
Validation | Loss:     1.2895 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.3159 | Accuracy:  90.9353% | Elapsed:     4s
Validation | Loss:     1.3248 | Accuracy:  68.0764% | Elapsed:     1s
Epoch 00056: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.3252 | Accuracy:  90.5233% | Elapsed:     4s
Validation | Loss:     1.2963 | Accuracy:  68.6221% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.3171 | Accuracy:  90.9353% | Elapsed:     4s
Validation | Loss:     1.2845 | Accuracy:  68.7585% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.3138 | Accuracy:  91.0177% | Elapsed:     4s
Validation | Loss:     1.2763 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.3110 | Accuracy:  91.0589% | Elapsed:     4s
Validation | Loss:     1.2713 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.3093 | Accuracy:  91.1001% | Elapsed:     3s
Validation | Loss:     1.2711 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.3084 | Accuracy:  91.1825% | Elapsed:     4s
Validation | Loss:     1.2741 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.3077 | Accuracy:  91.3061% | Elapsed:     4s
Validation | Loss:     1.2755 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.3070 | Accuracy:  91.2649% | Elapsed:     4s
Validation | Loss:     1.2768 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.3056 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2794 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.3051 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2812 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.3046 | Accuracy:  91.3061% | Elapsed:     4s
Validation | Loss:     1.2829 | Accuracy:  69.0314% | Elapsed:     1s
Epoch 00067: reducing learning rate of group 0 to 1.0000e-07.
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.3038 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2830 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.3038 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2830 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.3037 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2831 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.3037 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2832 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.3036 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2834 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.3036 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2836 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.3035 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2836 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.3035 | Accuracy:  91.3473% | Elapsed:     4s
Validation | Loss:     1.2837 | Accuracy:  69.0314% | Elapsed:     1s
================================================================================
Training complete in 5m 24s
Best model accuracy:  69.30%
================================================================================
|
```

|
|
|
|

```
================================================================================
Hidden Size = 256
RNN Layers = 2
L2 Regularization Weight = 0.01
--------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 256, num_layers=2, batch_first=True)
  (fc): Linear(in_features=256, out_features=10, bias=False)
)
--------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9610 | Accuracy:  23.8154% | Elapsed:     4s
Validation | Loss:     1.9024 | Accuracy:  35.8799% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.7979 | Accuracy:  30.3667% | Elapsed:     4s
Validation | Loss:     1.9154 | Accuracy:  38.7449% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.7051 | Accuracy:  33.8278% | Elapsed:     4s
Validation | Loss:     1.8241 | Accuracy:  27.5580% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.5488 | Accuracy:  40.9971% | Elapsed:     4s
Validation | Loss:     2.0651 | Accuracy:  28.3765% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.4921 | Accuracy:  42.7689% | Elapsed:     4s
Validation | Loss:     1.5802 | Accuracy:  39.4270% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.4468 | Accuracy:  45.2822% | Elapsed:     4s
Validation | Loss:     2.0031 | Accuracy:  23.8745% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.5354 | Accuracy:  42.3156% | Elapsed:     4s
Validation | Loss:     1.5078 | Accuracy:  45.1569% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.3875 | Accuracy:  47.0540% | Elapsed:     4s
Validation | Loss:     1.4941 | Accuracy:  47.6126% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.3322 | Accuracy:  50.3914% | Elapsed:     3s
Validation | Loss:     1.4401 | Accuracy:  48.4311% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.4504 | Accuracy:  46.8068% | Elapsed:     4s
Validation | Loss:     1.5202 | Accuracy:  43.7926% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.4177 | Accuracy:  46.8892% | Elapsed:     4s
Validation | Loss:     1.4957 | Accuracy:  44.3383% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.5342 | Accuracy:  42.1096% | Elapsed:     4s
Validation | Loss:     1.9919 | Accuracy:  26.7394% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.5931 | Accuracy:  38.1129% | Elapsed:     4s
Validation | Loss:     1.9031 | Accuracy:  36.5621% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.4984 | Accuracy:  42.0272% | Elapsed:     4s
Validation | Loss:     1.7744 | Accuracy:  37.3806% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.4115 | Accuracy:  48.2489% | Elapsed:     4s
Validation | Loss:     1.6579 | Accuracy:  42.7012% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.2846 | Accuracy:  51.3803% | Elapsed:     4s
Validation | Loss:     1.4661 | Accuracy:  46.6576% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.2161 | Accuracy:  55.3770% | Elapsed:     4s
Validation | Loss:     1.5254 | Accuracy:  44.0655% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.2614 | Accuracy:  55.7890% | Elapsed:     4s
Validation | Loss:     1.5019 | Accuracy:  46.2483% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.2793 | Accuracy:  54.5529% | Elapsed:     4s
Validation | Loss:     1.5414 | Accuracy:  42.1555% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.2134 | Accuracy:  58.8793% | Elapsed:     4s
Validation | Loss:     1.4264 | Accuracy:  47.8854% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.2051 | Accuracy:  56.9015% | Elapsed:     4s
Validation | Loss:     1.4400 | Accuracy:  52.3874% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.1887 | Accuracy:  59.0853% | Elapsed:     4s
Validation | Loss:     1.7919 | Accuracy:  43.7926% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.2798 | Accuracy:  52.2044% | Elapsed:     4s
Validation | Loss:     1.5669 | Accuracy:  40.2456% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.1623 | Accuracy:  57.6844% | Elapsed:     4s
Validation | Loss:     1.3548 | Accuracy:  49.1132% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.1434 | Accuracy:  59.9506% | Elapsed:     4s
Validation | Loss:     1.4374 | Accuracy:  48.4311% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.1994 | Accuracy:  58.0140% | Elapsed:     3s
Validation | Loss:     1.5520 | Accuracy:  47.0668% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.2815 | Accuracy:  54.5529% | Elapsed:     4s
Validation | Loss:     1.3356 | Accuracy:  53.8881% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     1.1647 | Accuracy:  57.8904% | Elapsed:     4s
Validation | Loss:     1.4201 | Accuracy:  50.8868% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.1452 | Accuracy:  59.2501% | Elapsed:     4s
Validation | Loss:     1.4574 | Accuracy:  52.2510% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.1659 | Accuracy:  58.4260% | Elapsed:     4s
Validation | Loss:     1.3437 | Accuracy:  53.6153% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.4151 | Accuracy:  49.5262% | Elapsed:     4s
Validation | Loss:     1.8141 | Accuracy:  30.2865% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     1.5006 | Accuracy:  45.8179% | Elapsed:     4s
Validation | Loss:     1.5796 | Accuracy:  40.6548% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     1.2337 | Accuracy:  56.5307% | Elapsed:     4s
Validation | Loss:     1.4539 | Accuracy:  53.7517% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     1.2338 | Accuracy:  56.6955% | Elapsed:     4s
Validation | Loss:     1.6982 | Accuracy:  40.7913% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.2549 | Accuracy:  54.9238% | Elapsed:     4s
Validation | Loss:     1.6703 | Accuracy:  40.3820% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     1.1062 | Accuracy:  60.3214% | Elapsed:     4s
Validation | Loss:     1.7438 | Accuracy:  39.2906% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     1.1798 | Accuracy:  57.8492% | Elapsed:     4s
Validation | Loss:     1.7135 | Accuracy:  41.3370% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     1.1122 | Accuracy:  60.2802% | Elapsed:     4s
Validation | Loss:     1.2959 | Accuracy:  49.1132% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     1.0659 | Accuracy:  62.7936% | Elapsed:     4s
Validation | Loss:     1.2272 | Accuracy:  57.2988% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     1.0401 | Accuracy:  63.5352% | Elapsed:     4s
Validation | Loss:     1.2670 | Accuracy:  54.4338% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     1.0812 | Accuracy:  62.1343% | Elapsed:     3s
Validation | Loss:     1.2901 | Accuracy:  58.1173% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     1.1280 | Accuracy:  60.3214% | Elapsed:     4s
```

```
Validation | Loss:     1.3589 | Accuracy:  52.6603% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     1.1111 | Accuracy:  61.3103% | Elapsed:     4s
Validation | Loss:     1.4422 | Accuracy:  53.0696% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.9938 | Accuracy:  65.1009% | Elapsed:     4s
Validation | Loss:     1.3325 | Accuracy:  51.1596% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9816 | Accuracy:  64.8949% | Elapsed:     4s
Validation | Loss:     1.3422 | Accuracy:  58.3902% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     1.2792 | Accuracy:  54.4705% | Elapsed:     4s
Validation | Loss:     1.3945 | Accuracy:  51.5689% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     1.3652 | Accuracy:  49.1141% | Elapsed:     4s
Validation | Loss:     1.6790 | Accuracy:  33.2879% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     1.3469 | Accuracy:  49.9794% | Elapsed:     4s
Validation | Loss:     1.4048 | Accuracy:  48.2947% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     1.2032 | Accuracy:  56.4895% | Elapsed:     4s
Validation | Loss:     1.2744 | Accuracy:  51.8417% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     1.1608 | Accuracy:  56.3659% | Elapsed:     4s
Validation | Loss:     1.3980 | Accuracy:  48.8404% | Elapsed:     1s
Epoch 00050: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     1.0981 | Accuracy:  61.1454% | Elapsed:     4s
Validation | Loss:     1.3627 | Accuracy:  51.5689% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.9844 | Accuracy:  66.9963% | Elapsed:     4s
Validation | Loss:     1.2523 | Accuracy:  55.1160% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.9231 | Accuracy:  68.2324% | Elapsed:     4s
Validation | Loss:     1.2085 | Accuracy:  56.4802% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.8836 | Accuracy:  69.5097% | Elapsed:     4s
Validation | Loss:     1.1701 | Accuracy:  57.0259% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.8546 | Accuracy:  70.5810% | Elapsed:     4s
Validation | Loss:     1.1480 | Accuracy:  59.2087% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.8868 | Accuracy:  68.2324% | Elapsed:     4s
Validation | Loss:     1.2196 | Accuracy:  53.8881% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.8804 | Accuracy:  68.0264% | Elapsed:     4s
Validation | Loss:     1.1934 | Accuracy:  59.8909% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.8442 | Accuracy:  70.7870% | Elapsed:     4s
Validation | Loss:     1.2000 | Accuracy:  59.2087% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.8110 | Accuracy:  72.3527% | Elapsed:     4s
Validation | Loss:     1.1565 | Accuracy:  61.2551% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.8035 | Accuracy:  73.3004% | Elapsed:     4s
Validation | Loss:     1.1929 | Accuracy:  58.2538% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.7951 | Accuracy:  73.2180% | Elapsed:     4s
Validation | Loss:     1.1574 | Accuracy:  61.1187% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.7830 | Accuracy:  73.0944% | Elapsed:     4s
Validation | Loss:     1.1691 | Accuracy:  59.3452% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.7646 | Accuracy:  74.4129% | Elapsed:     4s
Validation | Loss:     1.0714 | Accuracy:  63.8472% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.8175 | Accuracy:  70.1277% | Elapsed:     3s
Validation | Loss:     1.1909 | Accuracy:  57.5716% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 65/75
Training   | Loss:     0.8059 | Accuracy:  70.7870% | Elapsed:     4s
Validation | Loss:     1.1502 | Accuracy:  59.2087% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.7740 | Accuracy:  73.7124% | Elapsed:     4s
Validation | Loss:     1.1203 | Accuracy:  62.3465% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.7682 | Accuracy:  73.7124% | Elapsed:     4s
Validation | Loss:     1.0575 | Accuracy:  63.0286% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.7353 | Accuracy:  75.5253% | Elapsed:     4s
Validation | Loss:     1.3129 | Accuracy:  59.2087% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.7410 | Accuracy:  75.1545% | Elapsed:     4s
Validation | Loss:     1.0565 | Accuracy:  64.1201% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.7173 | Accuracy:  75.8550% | Elapsed:     4s
Validation | Loss:     1.1206 | Accuracy:  63.4379% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.7489 | Accuracy:  74.4953% | Elapsed:     4s
Validation | Loss:     1.1930 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.7196 | Accuracy:  75.3193% | Elapsed:     4s
Validation | Loss:     1.1077 | Accuracy:  63.8472% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.7114 | Accuracy:  76.7614% | Elapsed:     4s
Validation | Loss:     1.1654 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.7810 | Accuracy:  73.1768% | Elapsed:     4s
Validation | Loss:     1.2791 | Accuracy:  54.5703% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.7550 | Accuracy:  74.4953% | Elapsed:     4s
Validation | Loss:     1.0308 | Accuracy:  65.7572% | Elapsed:     1s
===========================================================================
Training complete in 5m 27s
Best model accuracy:  65.76%
===========================================================================
|
|
|
|
|

===========================================================================
Hidden Size = 512
RNN Layers = 1
L2 Regularization Weight = 0.0001
---------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 512, batch_first=True)
  (fc): Linear(in_features=512, out_features=10, bias=False)
)
---------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9226 | Accuracy:  27.6473% | Elapsed:     3s
Validation | Loss:     1.8563 | Accuracy:  33.4243% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5606 | Accuracy:  44.4582% | Elapsed:     3s
Validation | Loss:     1.6146 | Accuracy:  40.9277% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3188 | Accuracy:  52.5340% | Elapsed:     3s
Validation | Loss:     1.4598 | Accuracy:  45.2933% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.1600 | Accuracy:  59.6209% | Elapsed:     3s
Validation | Loss:     1.3198 | Accuracy:  52.9332% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.0535 | Accuracy:  63.9473% | Elapsed:     3s
Validation | Loss:     1.3092 | Accuracy:  52.1146% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     0.9826 | Accuracy:  65.6366% | Elapsed:     3s
Validation | Loss:     1.2719 | Accuracy:  57.7080% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.9072 | Accuracy:  69.7157% | Elapsed:     3s
Validation | Loss:     1.1610 | Accuracy:  57.8445% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.8439 | Accuracy:  72.8883% | Elapsed:     3s
Validation | Loss:     1.0718 | Accuracy:  63.0286% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.7878 | Accuracy:  75.1133% | Elapsed:     4s
Validation | Loss:     1.0811 | Accuracy:  59.4816% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.7515 | Accuracy:  75.2369% | Elapsed:     4s
Validation | Loss:     1.0449 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.7092 | Accuracy:  76.8850% | Elapsed:     4s
Validation | Loss:     1.0201 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.6553 | Accuracy:  80.0165% | Elapsed:     4s
Validation | Loss:     0.9425 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.6160 | Accuracy:  79.8105% | Elapsed:     4s
Validation | Loss:     1.0248 | Accuracy:  65.7572% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.5777 | Accuracy:  81.8706% | Elapsed:     4s
Validation | Loss:     1.1090 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.5534 | Accuracy:  82.9831% | Elapsed:     4s
Validation | Loss:     1.0012 | Accuracy:  65.3479% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.5226 | Accuracy:  84.3016% | Elapsed:     4s
Validation | Loss:     1.0874 | Accuracy:  64.1201% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.5496 | Accuracy:  83.0243% | Elapsed:     4s
Validation | Loss:     0.9854 | Accuracy:  66.4393% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.5511 | Accuracy:  82.6947% | Elapsed:     4s
Validation | Loss:     0.8531 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.5308 | Accuracy:  83.7660% | Elapsed:     4s
Validation | Loss:     0.9286 | Accuracy:  66.5757% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.5381 | Accuracy:  84.0132% | Elapsed:     4s
Validation | Loss:     0.9414 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.4926 | Accuracy:  84.9609% | Elapsed:     4s
Validation | Loss:     1.0895 | Accuracy:  65.3479% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.4639 | Accuracy:  86.0321% | Elapsed:     3s
Validation | Loss:     1.0006 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.4409 | Accuracy:  87.1034% | Elapsed:     4s
Validation | Loss:     0.8603 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.4278 | Accuracy:  87.5567% | Elapsed:     3s
Validation | Loss:     0.9378 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.4294 | Accuracy:  86.7738% | Elapsed:     3s
Validation | Loss:     0.9736 | Accuracy:  68.2128% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.4291 | Accuracy:  86.8150% | Elapsed:     3s
Validation | Loss:     0.8909 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.4039 | Accuracy:  88.3807% | Elapsed:     3s
Validation | Loss:     0.8067 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.4351 | Accuracy:  86.2794% | Elapsed:     4s
Validation | Loss:     0.9716 | Accuracy:  67.1214% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.4169 | Accuracy:  86.8562% | Elapsed:     3s
Validation | Loss:     0.9008 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.3952 | Accuracy:  88.1747% | Elapsed:     3s
```

```
Validation | Loss:     0.9149 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.4094 | Accuracy:  87.3094% | Elapsed:     3s
Validation | Loss:     0.8528 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.3955 | Accuracy:  88.4219% | Elapsed:     3s
Validation | Loss:     0.8360 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.3817 | Accuracy:  87.9275% | Elapsed:     3s
Validation | Loss:     0.8505 | Accuracy:  68.7585% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.3787 | Accuracy:  88.5455% | Elapsed:     3s
Validation | Loss:     0.8565 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.3866 | Accuracy:  88.2159% | Elapsed:     3s
Validation | Loss:     1.0680 | Accuracy:  65.6207% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.4016 | Accuracy:  87.3506% | Elapsed:     3s
Validation | Loss:     0.8833 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3622 | Accuracy:  89.2048% | Elapsed:     3s
Validation | Loss:     0.8408 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3657 | Accuracy:  88.8752% | Elapsed:     3s
Validation | Loss:     1.0016 | Accuracy:  69.1678% | Elapsed:     1s
Epoch 00038: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.2497 | Accuracy:  93.6547% | Elapsed:     3s
Validation | Loss:     0.7802 | Accuracy:  73.6698% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.2268 | Accuracy:  94.1492% | Elapsed:     3s
Validation | Loss:     0.7918 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.2212 | Accuracy:  94.3552% | Elapsed:     3s
Validation | Loss:     0.7455 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.2169 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.7941 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.2144 | Accuracy:  94.8496% | Elapsed:     3s
Validation | Loss:     0.8001 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2108 | Accuracy:  94.6024% | Elapsed:     3s
Validation | Loss:     0.7587 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2074 | Accuracy:  95.0556% | Elapsed:     4s
Validation | Loss:     0.8377 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2038 | Accuracy:  95.2616% | Elapsed:     3s
Validation | Loss:     0.7824 | Accuracy:  73.9427% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2013 | Accuracy:  95.0968% | Elapsed:     4s
Validation | Loss:     0.8155 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.1958 | Accuracy:  95.1792% | Elapsed:     3s
Validation | Loss:     0.8040 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.1915 | Accuracy:  95.4677% | Elapsed:     3s
Validation | Loss:     0.7738 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.1854 | Accuracy:  95.7149% | Elapsed:     3s
Validation | Loss:     0.7753 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.1830 | Accuracy:  95.8797% | Elapsed:     3s
Validation | Loss:     0.7726 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.1798 | Accuracy:  95.7973% | Elapsed:     4s
Validation | Loss:     0.7939 | Accuracy:  74.0791% | Elapsed:     1s
Epoch 00052: reducing learning rate of group 0 to 1.0000e-05.
```

```
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.1676 | Accuracy:  96.1681% | Elapsed:     3s
Validation | Loss:     0.7571 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.1642 | Accuracy:  96.5389% | Elapsed:     3s
Validation | Loss:     0.7494 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1630 | Accuracy:  96.7450% | Elapsed:     3s
Validation | Loss:     0.7556 | Accuracy:  75.0341% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1619 | Accuracy:  96.7450% | Elapsed:     3s
Validation | Loss:     0.7584 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1608 | Accuracy:  96.7450% | Elapsed:     3s
Validation | Loss:     0.7615 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1598 | Accuracy:  96.7037% | Elapsed:     3s
Validation | Loss:     0.7603 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1588 | Accuracy:  96.7862% | Elapsed:     3s
Validation | Loss:     0.7591 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1578 | Accuracy:  96.7450% | Elapsed:     3s
Validation | Loss:     0.7560 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1570 | Accuracy:  96.8274% | Elapsed:     3s
Validation | Loss:     0.7563 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1560 | Accuracy:  96.7450% | Elapsed:     3s
Validation | Loss:     0.7639 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1547 | Accuracy:  96.8274% | Elapsed:     3s
Validation | Loss:     0.7589 | Accuracy:  74.3520% | Elapsed:     1s
Epoch 00063: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1522 | Accuracy:  96.9510% | Elapsed:     3s
Validation | Loss:     0.7592 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1519 | Accuracy:  96.9510% | Elapsed:     3s
Validation | Loss:     0.7592 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1517 | Accuracy:  96.9510% | Elapsed:     3s
Validation | Loss:     0.7596 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1516 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     0.7597 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1514 | Accuracy:  96.9922% | Elapsed:     3s
Validation | Loss:     0.7604 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1513 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     0.7602 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1511 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     0.7601 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1510 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     0.7607 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1508 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     0.7602 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1507 | Accuracy:  96.9510% | Elapsed:     3s
Validation | Loss:     0.7605 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1505 | Accuracy:  96.9510% | Elapsed:     3s
Validation | Loss:     0.7601 | Accuracy:  74.4884% | Elapsed:     1s
Epoch 00074: reducing learning rate of group 0 to 1.0000e-07.
--------------------------------------------------------------------------------
```

```
Epoch 75/75
Training   | Loss:     0.1502 | Accuracy:  96.9922% | Elapsed:     3s
Validation | Loss:     0.7601 | Accuracy:  74.4884% | Elapsed:     1s
================================================================================
Training complete in 5m 8s
Best model accuracy:  75.03%
================================================================================
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================================================================================
Hidden Size = 512
RNN Layers = 1
L2 Regularization Weight = 0.001
--------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 512, batch_first=True)
  (fc): Linear(in_features=512, out_features=10, bias=False)
)
--------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9493 | Accuracy:  26.1640% | Elapsed:     3s
Validation | Loss:     1.8132 | Accuracy:  31.7872% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6157 | Accuracy:  41.6976% | Elapsed:     3s
Validation | Loss:     1.7022 | Accuracy:  40.6548% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3859 | Accuracy:  50.8859% | Elapsed:     3s
Validation | Loss:     1.4961 | Accuracy:  44.8840% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2467 | Accuracy:  56.3659% | Elapsed:     3s
Validation | Loss:     1.3475 | Accuracy:  50.7503% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1550 | Accuracy:  61.5575% | Elapsed:     3s
Validation | Loss:     1.3934 | Accuracy:  51.1596% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.0559 | Accuracy:  64.8537% | Elapsed:     3s
Validation | Loss:     1.3053 | Accuracy:  54.2974% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.9952 | Accuracy:  68.2324% | Elapsed:     3s
Validation | Loss:     1.1531 | Accuracy:  61.6644% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9084 | Accuracy:  71.5286% | Elapsed:     3s
Validation | Loss:     1.1739 | Accuracy:  62.2101% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.8758 | Accuracy:  72.9295% | Elapsed:     3s
Validation | Loss:     1.1007 | Accuracy:  63.9836% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8359 | Accuracy:  74.5365% | Elapsed:     3s
Validation | Loss:     1.1107 | Accuracy:  64.1201% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.7976 | Accuracy:  75.6489% | Elapsed:     3s
Validation | Loss:     1.0077 | Accuracy:  65.6207% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.7681 | Accuracy:  76.7614% | Elapsed:     3s
Validation | Loss:     1.0868 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.7381 | Accuracy:  77.2559% | Elapsed:     3s
Validation | Loss:     1.0390 | Accuracy:  65.6207% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.7663 | Accuracy:  75.8962% | Elapsed:     3s
Validation | Loss:     1.1596 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.7267 | Accuracy:  78.4920% | Elapsed:     3s
Validation | Loss:     1.2202 | Accuracy:  57.1623% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.6944 | Accuracy:  79.7281% | Elapsed:     3s
Validation | Loss:     1.0235 | Accuracy:  67.6671% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.6735 | Accuracy:  79.8105% | Elapsed:     3s
Validation | Loss:     0.9173 | Accuracy:  72.3056% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.6507 | Accuracy:  80.4285% | Elapsed:     3s
Validation | Loss:     1.0125 | Accuracy:  66.5757% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.6204 | Accuracy:  81.7470% | Elapsed:     3s
Validation | Loss:     0.9884 | Accuracy:  68.6221% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.6209 | Accuracy:  81.2526% | Elapsed:     3s
Validation | Loss:     1.3346 | Accuracy:  49.9318% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.6415 | Accuracy:  80.5933% | Elapsed:     3s
Validation | Loss:     1.0318 | Accuracy:  65.4843% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.6145 | Accuracy:  81.7058% | Elapsed:     3s
Validation | Loss:     0.9919 | Accuracy:  66.4393% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6042 | Accuracy:  82.5711% | Elapsed:     4s
Validation | Loss:     0.9381 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.6159 | Accuracy:  82.1178% | Elapsed:     4s
Validation | Loss:     1.2439 | Accuracy:  57.0259% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5794 | Accuracy:  82.7359% | Elapsed:     4s
Validation | Loss:     1.1038 | Accuracy:  66.0300% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.5814 | Accuracy:  83.2303% | Elapsed:     4s
Validation | Loss:     0.9968 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5833 | Accuracy:  83.6836% | Elapsed:     4s
Validation | Loss:     1.0447 | Accuracy:  68.4857% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.6077 | Accuracy:  82.4475% | Elapsed:     4s
Validation | Loss:     0.8940 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.6992 | Accuracy:  78.8628% | Elapsed:     4s
Validation | Loss:     0.9059 | Accuracy:  68.6221% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.6515 | Accuracy:  80.9642% | Elapsed:     3s
Validation | Loss:     1.0019 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.6025 | Accuracy:  82.1590% | Elapsed:     3s
Validation | Loss:     1.0013 | Accuracy:  62.7558% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.5889 | Accuracy:  82.5299% | Elapsed:     3s
Validation | Loss:     0.9546 | Accuracy:  66.0300% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.5558 | Accuracy:  83.8896% | Elapsed:     3s
Validation | Loss:     0.8944 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.5225 | Accuracy:  84.7136% | Elapsed:     3s
Validation | Loss:     0.9253 | Accuracy:  68.2128% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.5210 | Accuracy:  83.9308% | Elapsed:     3s
Validation | Loss:     0.8559 | Accuracy:  70.1228% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.5197 | Accuracy:  83.8072% | Elapsed:     3s
Validation | Loss:     0.8260 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.5349 | Accuracy:  84.7960% | Elapsed:     3s
Validation | Loss:     0.9485 | Accuracy:  65.7572% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.5409 | Accuracy:  84.0544% | Elapsed:     4s
Validation | Loss:     0.9246 | Accuracy:  67.2578% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.5451 | Accuracy:  84.5488% | Elapsed:     3s
Validation | Loss:     0.9178 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.5304 | Accuracy:  84.7960% | Elapsed:     3s
```

```
Validation | Loss:     0.8964 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.5163 | Accuracy:  84.7548% | Elapsed:     3s
Validation | Loss:     0.8962 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.4708 | Accuracy:  86.4030% | Elapsed:     3s
Validation | Loss:     0.7792 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.4701 | Accuracy:  86.6914% | Elapsed:     3s
Validation | Loss:     0.9579 | Accuracy:  68.2128% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.4770 | Accuracy:  85.8261% | Elapsed:     3s
Validation | Loss:     0.9661 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.4802 | Accuracy:  86.4854% | Elapsed:     3s
Validation | Loss:     0.8736 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.4962 | Accuracy:  85.5377% | Elapsed:     3s
Validation | Loss:     0.8949 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.5059 | Accuracy:  85.6201% | Elapsed:     3s
Validation | Loss:     0.8800 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.5474 | Accuracy:  84.1368% | Elapsed:     3s
Validation | Loss:     0.8919 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.5414 | Accuracy:  83.9720% | Elapsed:     3s
Validation | Loss:     0.9044 | Accuracy:  67.2578% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.5688 | Accuracy:  82.9419% | Elapsed:     3s
Validation | Loss:     1.0193 | Accuracy:  66.3029% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.5452 | Accuracy:  83.9720% | Elapsed:     3s
Validation | Loss:     0.8635 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.4842 | Accuracy:  86.1145% | Elapsed:     3s
Validation | Loss:     1.0668 | Accuracy:  65.6207% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.4943 | Accuracy:  85.9909% | Elapsed:     3s
Validation | Loss:     0.8175 | Accuracy:  72.3056% | Elapsed:     1s
Epoch 00053: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.3983 | Accuracy:  89.6992% | Elapsed:     3s
Validation | Loss:     0.7925 | Accuracy:  71.6235% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.3847 | Accuracy:  90.7293% | Elapsed:     3s
Validation | Loss:     0.8024 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.3801 | Accuracy:  91.1825% | Elapsed:     3s
Validation | Loss:     0.7892 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.3751 | Accuracy:  91.1825% | Elapsed:     3s
Validation | Loss:     0.8032 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.3701 | Accuracy:  90.9353% | Elapsed:     3s
Validation | Loss:     0.8427 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.3638 | Accuracy:  90.9353% | Elapsed:     3s
Validation | Loss:     0.8028 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.3565 | Accuracy:  90.9765% | Elapsed:     3s
Validation | Loss:     0.8197 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.3492 | Accuracy:  91.9242% | Elapsed:     4s
Validation | Loss:     0.8091 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.3448 | Accuracy:  91.5534% | Elapsed:     4s
Validation | Loss:     0.8079 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 63/75
Training   | Loss:     0.3392 | Accuracy:  92.0890% | Elapsed:     3s
Validation | Loss:     0.7994 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.3371 | Accuracy:  92.0478% | Elapsed:     3s
Validation | Loss:     0.8040 | Accuracy:  72.7149% | Elapsed:     1s
Epoch 00064: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.3198 | Accuracy:  92.8307% | Elapsed:     4s
Validation | Loss:     0.8004 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.3172 | Accuracy:  92.9543% | Elapsed:     3s
Validation | Loss:     0.8023 | Accuracy:  72.3056% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.3158 | Accuracy:  93.0367% | Elapsed:     3s
Validation | Loss:     0.8062 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.3147 | Accuracy:  93.0779% | Elapsed:     3s
Validation | Loss:     0.8022 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.3136 | Accuracy:  92.9543% | Elapsed:     3s
Validation | Loss:     0.8000 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.3125 | Accuracy:  93.2015% | Elapsed:     3s
Validation | Loss:     0.8050 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.3110 | Accuracy:  93.0779% | Elapsed:     4s
Validation | Loss:     0.8099 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.3098 | Accuracy:  93.1191% | Elapsed:     3s
Validation | Loss:     0.8115 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.3087 | Accuracy:  92.9543% | Elapsed:     3s
Validation | Loss:     0.7984 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.3065 | Accuracy:  93.2839% | Elapsed:     3s
Validation | Loss:     0.7937 | Accuracy:  72.3056% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.3039 | Accuracy:  93.5311% | Elapsed:     3s
Validation | Loss:     0.7932 | Accuracy:  72.5784% | Elapsed:     1s
Epoch 00075: reducing learning rate of group 0 to 1.0000e-06.
===========================================================================
Training complete in 5m 8s
Best model accuracy:  73.81%
===========================================================================
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===========================================================================
Hidden Size = 512
RNN Layers = 1
L2 Regularization Weight = 0.01
---------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 512, batch_first=True)
  (fc): Linear(in_features=512, out_features=10, bias=False)
)
---------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9499 | Accuracy:  27.5649% | Elapsed:     3s
Validation | Loss:     1.9351 | Accuracy:  31.6508% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.7083 | Accuracy:  37.8245% | Elapsed:     3s
Validation | Loss:     1.8438 | Accuracy:  31.9236% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.5909 | Accuracy:  41.8212% | Elapsed:     3s
Validation | Loss:     1.6631 | Accuracy:  38.1992% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.4945 | Accuracy:  47.3012% | Elapsed:     3s
Validation | Loss:     1.7012 | Accuracy:  41.4734% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
```

```
Training   | Loss:     1.4437 | Accuracy:  49.1965% | Elapsed:     3s
Validation | Loss:     1.7698 | Accuracy:  35.8799% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.4220 | Accuracy:  49.9382% | Elapsed:     3s
Validation | Loss:     1.5486 | Accuracy:  49.2497% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.3530 | Accuracy:  52.0808% | Elapsed:     4s
Validation | Loss:     1.6327 | Accuracy:  38.7449% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.3361 | Accuracy:  53.7701% | Elapsed:     3s
Validation | Loss:     1.4825 | Accuracy:  52.6603% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.2849 | Accuracy:  55.9951% | Elapsed:     4s
Validation | Loss:     1.4915 | Accuracy:  47.7490% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.2840 | Accuracy:  56.1599% | Elapsed:     3s
Validation | Loss:     1.5991 | Accuracy:  43.3834% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.2837 | Accuracy:  56.9839% | Elapsed:     3s
Validation | Loss:     1.4629 | Accuracy:  51.9782% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.2531 | Accuracy:  58.1788% | Elapsed:     3s
Validation | Loss:     1.4489 | Accuracy:  50.7503% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.2484 | Accuracy:  59.2089% | Elapsed:     3s
Validation | Loss:     1.4565 | Accuracy:  53.8881% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.2409 | Accuracy:  59.3737% | Elapsed:     3s
Validation | Loss:     1.3733 | Accuracy:  53.3424% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.2086 | Accuracy:  61.4339% | Elapsed:     3s
Validation | Loss:     1.4254 | Accuracy:  52.5239% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.1913 | Accuracy:  61.9283% | Elapsed:     4s
Validation | Loss:     1.3763 | Accuracy:  51.8417% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.1412 | Accuracy:  64.6889% | Elapsed:     4s
Validation | Loss:     1.3989 | Accuracy:  53.8881% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.1561 | Accuracy:  63.4528% | Elapsed:     4s
Validation | Loss:     1.3374 | Accuracy:  52.1146% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.1261 | Accuracy:  64.8949% | Elapsed:     3s
Validation | Loss:     1.3059 | Accuracy:  54.7067% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.1078 | Accuracy:  66.2134% | Elapsed:     3s
Validation | Loss:     1.4274 | Accuracy:  50.7503% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.1191 | Accuracy:  66.0898% | Elapsed:     3s
Validation | Loss:     1.2539 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.0745 | Accuracy:  67.2847% | Elapsed:     3s
Validation | Loss:     1.3274 | Accuracy:  56.2074% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.0719 | Accuracy:  69.2625% | Elapsed:     3s
Validation | Loss:     1.3106 | Accuracy:  59.0723% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.0888 | Accuracy:  67.3671% | Elapsed:     3s
Validation | Loss:     1.3010 | Accuracy:  58.6630% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.0826 | Accuracy:  67.1199% | Elapsed:     3s
Validation | Loss:     1.3115 | Accuracy:  54.1610% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.0537 | Accuracy:  68.1088% | Elapsed:     3s
Validation | Loss:     1.3207 | Accuracy:  58.6630% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.0262 | Accuracy:  69.8805% | Elapsed:     3s
Validation | Loss:     1.2094 | Accuracy:  64.1201% | Elapsed:     1s
---------------------------------------------------------------------------
```

```
Epoch 28/75
Training   | Loss:     1.0168 | Accuracy:  69.9217% | Elapsed:     3s
Validation | Loss:     1.2507 | Accuracy:  60.9823% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.0303 | Accuracy:  69.0564% | Elapsed:     3s
Validation | Loss:     1.3023 | Accuracy:  58.2538% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.0358 | Accuracy:  68.5620% | Elapsed:     3s
Validation | Loss:     1.2229 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.0163 | Accuracy:  69.8805% | Elapsed:     3s
Validation | Loss:     1.1968 | Accuracy:  59.7544% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     1.0020 | Accuracy:  70.5810% | Elapsed:     3s
Validation | Loss:     1.2316 | Accuracy:  60.8458% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     1.0077 | Accuracy:  72.5587% | Elapsed:     3s
Validation | Loss:     1.3581 | Accuracy:  57.0259% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     1.0047 | Accuracy:  70.6634% | Elapsed:     3s
Validation | Loss:     1.2073 | Accuracy:  60.5730% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.0299 | Accuracy:  71.2814% | Elapsed:     4s
Validation | Loss:     1.3766 | Accuracy:  53.2060% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     1.0132 | Accuracy:  70.4162% | Elapsed:     4s
Validation | Loss:     1.2043 | Accuracy:  65.4843% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     1.0024 | Accuracy:  71.6110% | Elapsed:     4s
Validation | Loss:     1.2286 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.9941 | Accuracy:  71.5286% | Elapsed:     4s
Validation | Loss:     1.2292 | Accuracy:  58.9359% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.9677 | Accuracy:  73.0944% | Elapsed:     4s
Validation | Loss:     1.3411 | Accuracy:  51.8417% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.9921 | Accuracy:  72.0231% | Elapsed:     4s
Validation | Loss:     1.1831 | Accuracy:  65.2115% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.9763 | Accuracy:  71.8995% | Elapsed:     4s
Validation | Loss:     1.2235 | Accuracy:  61.6644% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.9542 | Accuracy:  72.7235% | Elapsed:     4s
Validation | Loss:     1.2514 | Accuracy:  60.7094% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.9493 | Accuracy:  72.5175% | Elapsed:     3s
Validation | Loss:     1.1632 | Accuracy:  62.8922% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.9522 | Accuracy:  73.7536% | Elapsed:     4s
Validation | Loss:     1.1548 | Accuracy:  64.3929% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9520 | Accuracy:  73.4240% | Elapsed:     3s
Validation | Loss:     1.2084 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.9385 | Accuracy:  74.4129% | Elapsed:     3s
Validation | Loss:     1.1900 | Accuracy:  62.8922% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.9498 | Accuracy:  72.6411% | Elapsed:     3s
Validation | Loss:     1.1588 | Accuracy:  65.8936% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.9285 | Accuracy:  75.4841% | Elapsed:     3s
Validation | Loss:     1.1930 | Accuracy:  64.3929% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.9477 | Accuracy:  74.2892% | Elapsed:     3s
Validation | Loss:     1.1626 | Accuracy:  66.0300% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.9482 | Accuracy:  74.5777% | Elapsed:     3s
Validation | Loss:     1.1975 | Accuracy:  60.9823% | Elapsed:     1s
```

```
-------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.9425 | Accuracy:  73.9184% | Elapsed:     3s
Validation | Loss:     1.1821 | Accuracy:  59.8909% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.9210 | Accuracy:  74.8661% | Elapsed:     3s
Validation | Loss:     1.2174 | Accuracy:  63.1651% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.9213 | Accuracy:  74.2892% | Elapsed:     4s
Validation | Loss:     1.1588 | Accuracy:  64.6658% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.9237 | Accuracy:  75.6489% | Elapsed:     4s
Validation | Loss:     1.1391 | Accuracy:  64.3929% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.9045 | Accuracy:  76.2670% | Elapsed:     4s
Validation | Loss:     1.1640 | Accuracy:  65.0750% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.9071 | Accuracy:  75.3193% | Elapsed:     4s
Validation | Loss:     1.2205 | Accuracy:  62.2101% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.9243 | Accuracy:  74.7837% | Elapsed:     3s
Validation | Loss:     1.1574 | Accuracy:  62.7558% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.9013 | Accuracy:  75.6902% | Elapsed:     4s
Validation | Loss:     1.0855 | Accuracy:  68.2128% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.8929 | Accuracy:  75.8962% | Elapsed:     3s
Validation | Loss:     1.1518 | Accuracy:  63.9836% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.8988 | Accuracy:  75.1957% | Elapsed:     3s
Validation | Loss:     1.1122 | Accuracy:  63.3015% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.9084 | Accuracy:  75.6902% | Elapsed:     3s
Validation | Loss:     1.1192 | Accuracy:  67.8035% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.9040 | Accuracy:  75.3605% | Elapsed:     3s
Validation | Loss:     1.1137 | Accuracy:  66.9850% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.9029 | Accuracy:  75.6077% | Elapsed:     3s
Validation | Loss:     1.1772 | Accuracy:  62.6194% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.8873 | Accuracy:  76.4318% | Elapsed:     3s
Validation | Loss:     1.1240 | Accuracy:  65.3479% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.8966 | Accuracy:  75.4429% | Elapsed:     4s
Validation | Loss:     1.1519 | Accuracy:  64.8022% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.8827 | Accuracy:  76.5142% | Elapsed:     3s
Validation | Loss:     1.2041 | Accuracy:  59.4816% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.9064 | Accuracy:  75.5253% | Elapsed:     3s
Validation | Loss:     1.1714 | Accuracy:  63.3015% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.8876 | Accuracy:  77.0499% | Elapsed:     4s
Validation | Loss:     1.2345 | Accuracy:  56.6166% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.8973 | Accuracy:  76.5554% | Elapsed:     4s
Validation | Loss:     1.2347 | Accuracy:  61.2551% | Elapsed:     1s
Epoch 00069: reducing learning rate of group 0 to 1.0000e-04.
-------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.8065 | Accuracy:  80.4285% | Elapsed:     4s
Validation | Loss:     1.0677 | Accuracy:  68.8950% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.7790 | Accuracy:  80.9642% | Elapsed:     4s
Validation | Loss:     1.0704 | Accuracy:  66.7121% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.7699 | Accuracy:  80.9642% | Elapsed:     3s
Validation | Loss:     1.0590 | Accuracy:  70.1228% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 73/75
```

```
Training   | Loss:     0.7635 | Accuracy:  81.9530% | Elapsed:     3s
Validation | Loss:     1.0600 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.7602 | Accuracy:  81.9530% | Elapsed:     3s
Validation | Loss:     1.0180 | Accuracy:  70.3956% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.7531 | Accuracy:  81.7470% | Elapsed:     3s
Validation | Loss:     1.0295 | Accuracy:  71.4870% | Elapsed:     1s
===========================================================================
Training complete in 5m 11s
Best model accuracy:  72.03%
===========================================================================
|
|
|
|
|

===========================================================================
Hidden Size = 512
RNN Layers = 2
L2 Regularization Weight = 0.0001
---------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 512, num_layers=2, batch_first=True)
  (fc): Linear(in_features=512, out_features=10, bias=False)
)
---------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9435 | Accuracy:  23.4446% | Elapsed:     4s
Validation | Loss:     1.9805 | Accuracy:  28.6494% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6229 | Accuracy:  37.1652% | Elapsed:     4s
Validation | Loss:     1.7808 | Accuracy:  31.3779% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4158 | Accuracy:  45.7767% | Elapsed:     4s
Validation | Loss:     1.5446 | Accuracy:  42.4284% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.3287 | Accuracy:  48.2901% | Elapsed:     4s
Validation | Loss:     1.4369 | Accuracy:  45.7026% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1633 | Accuracy:  54.8414% | Elapsed:     4s
Validation | Loss:     1.2594 | Accuracy:  48.7040% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.1404 | Accuracy:  58.5496% | Elapsed:     4s
Validation | Loss:     1.2328 | Accuracy:  55.6617% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.0492 | Accuracy:  60.1154% | Elapsed:     4s
Validation | Loss:     1.2434 | Accuracy:  53.7517% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9861 | Accuracy:  63.7824% | Elapsed:     4s
Validation | Loss:     1.1471 | Accuracy:  55.7981% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.9051 | Accuracy:  67.7379% | Elapsed:     4s
Validation | Loss:     1.2919 | Accuracy:  55.7981% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8886 | Accuracy:  68.4796% | Elapsed:     4s
Validation | Loss:     1.0339 | Accuracy:  63.3015% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.9431 | Accuracy:  67.6967% | Elapsed:     4s
Validation | Loss:     1.5954 | Accuracy:  52.7967% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.7820 | Accuracy:  72.8471% | Elapsed:     4s
Validation | Loss:     1.1679 | Accuracy:  56.7531% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.7402 | Accuracy:  73.0944% | Elapsed:     4s
Validation | Loss:     1.0372 | Accuracy:  67.8035% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.6901 | Accuracy:  75.9374% | Elapsed:     4s
Validation | Loss:     1.0323 | Accuracy:  66.3029% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.6953 | Accuracy:  76.6790% | Elapsed:     4s
Validation | Loss:     0.9971 | Accuracy:  66.7121% | Elapsed:     1s
---------------------------------------------------------------------------
```

```
Epoch 16/75
Training   | Loss:     0.6193 | Accuracy:  78.9040% | Elapsed:     4s
Validation | Loss:     1.0238 | Accuracy:  68.0764% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.6172 | Accuracy:  79.1100% | Elapsed:     4s
Validation | Loss:     1.0303 | Accuracy:  66.0300% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.6381 | Accuracy:  78.6568% | Elapsed:     4s
Validation | Loss:     1.1872 | Accuracy:  64.2565% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.6049 | Accuracy:  78.6980% | Elapsed:     4s
Validation | Loss:     1.2547 | Accuracy:  59.4816% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.5742 | Accuracy:  79.8105% | Elapsed:     4s
Validation | Loss:     1.2147 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.5839 | Accuracy:  79.6044% | Elapsed:     4s
Validation | Loss:     0.9624 | Accuracy:  66.7121% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.5360 | Accuracy:  81.4174% | Elapsed:     4s
Validation | Loss:     0.8610 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.4791 | Accuracy:  84.0544% | Elapsed:     4s
Validation | Loss:     1.0160 | Accuracy:  67.5307% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.4600 | Accuracy:  84.1368% | Elapsed:     4s
Validation | Loss:     1.0386 | Accuracy:  68.6221% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.4616 | Accuracy:  84.1368% | Elapsed:     4s
Validation | Loss:     1.1795 | Accuracy:  66.0300% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.4788 | Accuracy:  83.7248% | Elapsed:     4s
Validation | Loss:     1.0401 | Accuracy:  69.3042% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.4827 | Accuracy:  83.4775% | Elapsed:     4s
Validation | Loss:     0.9672 | Accuracy:  71.3506% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.4123 | Accuracy:  85.4141% | Elapsed:     4s
Validation | Loss:     1.0652 | Accuracy:  70.9413% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.3738 | Accuracy:  87.4330% | Elapsed:     4s
Validation | Loss:     1.2526 | Accuracy:  66.0300% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.3838 | Accuracy:  87.2270% | Elapsed:     4s
Validation | Loss:     1.2795 | Accuracy:  66.0300% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.4061 | Accuracy:  85.9497% | Elapsed:     4s
Validation | Loss:     0.8478 | Accuracy:  73.2606% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.3948 | Accuracy:  87.1034% | Elapsed:     4s
Validation | Loss:     1.0497 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.3606 | Accuracy:  87.5567% | Elapsed:     4s
Validation | Loss:     0.9952 | Accuracy:  73.8063% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.3849 | Accuracy:  86.9798% | Elapsed:     4s
Validation | Loss:     0.8774 | Accuracy:  74.0791% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.3785 | Accuracy:  87.3506% | Elapsed:     4s
Validation | Loss:     1.0672 | Accuracy:  69.7135% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.3606 | Accuracy:  88.2983% | Elapsed:     4s
Validation | Loss:     0.9918 | Accuracy:  73.8063% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3722 | Accuracy:  87.5155% | Elapsed:     4s
Validation | Loss:     1.1247 | Accuracy:  70.8049% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3398 | Accuracy:  88.2159% | Elapsed:     4s
Validation | Loss:     1.3971 | Accuracy:  67.1214% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3511 | Accuracy:  88.1335% | Elapsed:     4s
Validation | Loss:     1.0960 | Accuracy:  68.3492% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.3288 | Accuracy:  89.6168% | Elapsed:     4s
Validation | Loss:     0.8697 | Accuracy:  75.1705% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3656 | Accuracy:  87.1858% | Elapsed:     4s
Validation | Loss:     0.7379 | Accuracy:  75.5798% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.3697 | Accuracy:  87.8451% | Elapsed:     4s
Validation | Loss:     1.1725 | Accuracy:  68.6221% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3367 | Accuracy:  89.0812% | Elapsed:     4s
Validation | Loss:     0.9839 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2965 | Accuracy:  90.6881% | Elapsed:     4s
Validation | Loss:     1.1136 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.3522 | Accuracy:  87.8863% | Elapsed:     4s
Validation | Loss:     1.0496 | Accuracy:  70.2592% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.3532 | Accuracy:  88.9576% | Elapsed:     4s
Validation | Loss:     1.0138 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2908 | Accuracy:  90.5233% | Elapsed:     4s
Validation | Loss:     1.0326 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.3541 | Accuracy:  87.4742% | Elapsed:     4s
Validation | Loss:     0.9840 | Accuracy:  68.4857% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.3409 | Accuracy:  88.6279% | Elapsed:     4s
Validation | Loss:     1.0600 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2568 | Accuracy:  91.9654% | Elapsed:     4s
Validation | Loss:     1.0498 | Accuracy:  73.9427% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2720 | Accuracy:  91.2649% | Elapsed:     4s
Validation | Loss:     1.0954 | Accuracy:  70.5321% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2940 | Accuracy:  90.2761% | Elapsed:     4s
Validation | Loss:     1.2375 | Accuracy:  70.9413% | Elapsed:     1s
Epoch 00052: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.1772 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     1.0278 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.1375 | Accuracy:  95.7973% | Elapsed:     4s
Validation | Loss:     1.0718 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1229 | Accuracy:  96.5389% | Elapsed:     4s
Validation | Loss:     1.0230 | Accuracy:  75.9891% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1140 | Accuracy:  96.7037% | Elapsed:     4s
Validation | Loss:     1.1004 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1027 | Accuracy:  97.2394% | Elapsed:     4s
Validation | Loss:     1.0841 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.0973 | Accuracy:  97.4866% | Elapsed:     4s
Validation | Loss:     1.0750 | Accuracy:  75.0341% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.0894 | Accuracy:  97.8986% | Elapsed:     4s
Validation | Loss:     1.2141 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.0843 | Accuracy:  97.9810% | Elapsed:     4s
Validation | Loss:     1.2024 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
```

```
Training   | Loss:     0.0821 | Accuracy:  97.8162% | Elapsed:     4s
Validation | Loss:     1.1480 | Accuracy:  75.0341% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.0770 | Accuracy:  98.1047% | Elapsed:     4s
Validation | Loss:     1.1645 | Accuracy:  75.1705% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.0706 | Accuracy:  98.1459% | Elapsed:     4s
Validation | Loss:     1.2343 | Accuracy:  73.9427% | Elapsed:     1s
Epoch 00063: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.0630 | Accuracy:  98.5579% | Elapsed:     4s
Validation | Loss:     1.2436 | Accuracy:  73.8063% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.0607 | Accuracy:  98.5579% | Elapsed:     4s
Validation | Loss:     1.2457 | Accuracy:  74.0791% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.0597 | Accuracy:  98.5991% | Elapsed:     4s
Validation | Loss:     1.2562 | Accuracy:  73.9427% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.0589 | Accuracy:  98.5579% | Elapsed:     4s
Validation | Loss:     1.2648 | Accuracy:  74.0791% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.0578 | Accuracy:  98.5991% | Elapsed:     4s
Validation | Loss:     1.2654 | Accuracy:  74.3520% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.0568 | Accuracy:  98.6815% | Elapsed:     4s
Validation | Loss:     1.2797 | Accuracy:  74.3520% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.0558 | Accuracy:  98.6815% | Elapsed:     4s
Validation | Loss:     1.2779 | Accuracy:  74.8977% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.0547 | Accuracy:  98.7227% | Elapsed:     4s
Validation | Loss:     1.2724 | Accuracy:  74.6248% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.0537 | Accuracy:  98.7639% | Elapsed:     4s
Validation | Loss:     1.2857 | Accuracy:  74.2156% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.0530 | Accuracy:  98.8051% | Elapsed:     4s
Validation | Loss:     1.3134 | Accuracy:  74.2156% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.0521 | Accuracy:  98.7639% | Elapsed:     4s
Validation | Loss:     1.3283 | Accuracy:  74.2156% | Elapsed:     1s
Epoch 00074: reducing learning rate of group 0 to 1.0000e-06.
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.0504 | Accuracy:  98.8875% | Elapsed:     4s
Validation | Loss:     1.3289 | Accuracy:  74.3520% | Elapsed:     1s
===========================================================================
Training complete in 5m 37s
Best model accuracy:  75.99%
===========================================================================
|
|
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|
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===========================================================================
Hidden Size = 512
RNN Layers = 2
L2 Regularization Weight = 0.001
---------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 512, num_layers=2, batch_first=True)
  (fc): Linear(in_features=512, out_features=10, bias=False)
)
---------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9076 | Accuracy:  28.3890% | Elapsed:     4s
Validation | Loss:     1.6519 | Accuracy:  40.9277% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5308 | Accuracy:  42.8925% | Elapsed:     4s
Validation | Loss:     1.6013 | Accuracy:  43.3834% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3790 | Accuracy:  47.0128% | Elapsed:     4s
```

```
Validation | Loss:     1.5459 | Accuracy:  37.3806% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2800 | Accuracy:  49.9794% | Elapsed:     4s
Validation | Loss:     1.2498 | Accuracy:  52.3874% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.2128 | Accuracy:  55.0474% | Elapsed:     4s
Validation | Loss:     1.3317 | Accuracy:  53.7517% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.0946 | Accuracy:  58.8793% | Elapsed:     4s
Validation | Loss:     1.2360 | Accuracy:  56.4802% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.0645 | Accuracy:  60.3626% | Elapsed:     4s
Validation | Loss:     1.3181 | Accuracy:  53.8881% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9370 | Accuracy:  67.2847% | Elapsed:     4s
Validation | Loss:     1.2332 | Accuracy:  55.3888% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.9475 | Accuracy:  65.9662% | Elapsed:     4s
Validation | Loss:     1.2940 | Accuracy:  56.2074% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8890 | Accuracy:  68.2736% | Elapsed:     4s
Validation | Loss:     1.1551 | Accuracy:  61.6644% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.8408 | Accuracy:  70.4986% | Elapsed:     4s
Validation | Loss:     1.1029 | Accuracy:  59.7544% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.8388 | Accuracy:  70.7458% | Elapsed:     4s
Validation | Loss:     0.9808 | Accuracy:  65.2115% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.8429 | Accuracy:  70.3749% | Elapsed:     4s
Validation | Loss:     1.1122 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.8492 | Accuracy:  70.5398% | Elapsed:     4s
Validation | Loss:     1.0935 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.7692 | Accuracy:  73.3828% | Elapsed:     4s
Validation | Loss:     1.1332 | Accuracy:  63.7108% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.9957 | Accuracy:  65.2658% | Elapsed:     4s
Validation | Loss:     1.4138 | Accuracy:  49.7954% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.8438 | Accuracy:  70.7046% | Elapsed:     4s
Validation | Loss:     1.2205 | Accuracy:  63.1651% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.7663 | Accuracy:  73.6712% | Elapsed:     4s
Validation | Loss:     1.0045 | Accuracy:  66.7121% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.8170 | Accuracy:  71.1578% | Elapsed:     4s
Validation | Loss:     1.5654 | Accuracy:  44.7476% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.7434 | Accuracy:  74.1656% | Elapsed:     4s
Validation | Loss:     1.3777 | Accuracy:  60.8458% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.6878 | Accuracy:  76.3494% | Elapsed:     4s
Validation | Loss:     0.9930 | Accuracy:  69.8499% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.7757 | Accuracy:  72.1467% | Elapsed:     4s
Validation | Loss:     0.9089 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.7117 | Accuracy:  76.1022% | Elapsed:     4s
Validation | Loss:     1.1658 | Accuracy:  63.3015% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.7256 | Accuracy:  75.8550% | Elapsed:     4s
Validation | Loss:     1.1596 | Accuracy:  57.2988% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.7221 | Accuracy:  74.6601% | Elapsed:     4s
Validation | Loss:     1.1370 | Accuracy:  61.6644% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
```

```
Training   | Loss:     0.6168 | Accuracy:  78.9040% | Elapsed:     4s
Validation | Loss:     0.9997 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5700 | Accuracy:  80.4285% | Elapsed:     4s
Validation | Loss:     1.1602 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.7299 | Accuracy:  74.3304% | Elapsed:     4s
Validation | Loss:     1.2041 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.9929 | Accuracy:  65.4306% | Elapsed:     4s
Validation | Loss:     1.4805 | Accuracy:  49.5225% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.8919 | Accuracy:  68.6032% | Elapsed:     4s
Validation | Loss:     1.3187 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.7239 | Accuracy:  75.8550% | Elapsed:     4s
Validation | Loss:     0.8483 | Accuracy:  70.2592% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.6650 | Accuracy:  78.3272% | Elapsed:     4s
Validation | Loss:     1.0429 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.6360 | Accuracy:  78.6156% | Elapsed:     4s
Validation | Loss:     0.8956 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.6130 | Accuracy:  79.1512% | Elapsed:     4s
Validation | Loss:     0.8584 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.5649 | Accuracy:  81.9942% | Elapsed:     4s
Validation | Loss:     1.3490 | Accuracy:  56.7531% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.5658 | Accuracy:  81.6234% | Elapsed:     4s
Validation | Loss:     0.8616 | Accuracy:  73.6698% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.6118 | Accuracy:  80.5521% | Elapsed:     4s
Validation | Loss:     1.5999 | Accuracy:  54.1610% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.7310 | Accuracy:  75.6489% | Elapsed:     4s
Validation | Loss:     1.0429 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.6577 | Accuracy:  77.8327% | Elapsed:     4s
Validation | Loss:     0.8580 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.5771 | Accuracy:  81.5822% | Elapsed:     4s
Validation | Loss:     0.8405 | Accuracy:  75.3070% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.6260 | Accuracy:  78.5744% | Elapsed:     4s
Validation | Loss:     1.1301 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.6531 | Accuracy:  78.3684% | Elapsed:     4s
Validation | Loss:     0.8167 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.5108 | Accuracy:  84.3428% | Elapsed:     4s
Validation | Loss:     0.8277 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.4369 | Accuracy:  85.7025% | Elapsed:     4s
Validation | Loss:     1.0223 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.6929 | Accuracy:  75.6902% | Elapsed:     4s
Validation | Loss:     1.0672 | Accuracy:  61.1187% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.6921 | Accuracy:  75.1957% | Elapsed:     4s
Validation | Loss:     1.1618 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.6418 | Accuracy:  78.1211% | Elapsed:     4s
Validation | Loss:     1.0787 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.5970 | Accuracy:  79.1100% | Elapsed:     4s
Validation | Loss:     1.0260 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 49/75
Training   | Loss:     0.5890 | Accuracy:  80.1401% | Elapsed:     4s
Validation | Loss:     0.9440 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.7889 | Accuracy:  72.8883% | Elapsed:     4s
Validation | Loss:     1.2659 | Accuracy:  57.9809% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.7441 | Accuracy:  72.1055% | Elapsed:     4s
Validation | Loss:     1.0749 | Accuracy:  61.2551% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.6306 | Accuracy:  77.6679% | Elapsed:     4s
Validation | Loss:     1.1665 | Accuracy:  60.5730% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.5775 | Accuracy:  80.5933% | Elapsed:     4s
Validation | Loss:     1.1108 | Accuracy:  68.0764% | Elapsed:     1s
Epoch 00053: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.4242 | Accuracy:  86.1970% | Elapsed:     4s
Validation | Loss:     0.9760 | Accuracy:  69.5771% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.3684 | Accuracy:  88.1747% | Elapsed:     4s
Validation | Loss:     1.0349 | Accuracy:  69.7135% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.3489 | Accuracy:  88.7103% | Elapsed:     4s
Validation | Loss:     0.9328 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.3350 | Accuracy:  89.3284% | Elapsed:     4s
Validation | Loss:     1.0053 | Accuracy:  71.8963% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.3193 | Accuracy:  89.4932% | Elapsed:     4s
Validation | Loss:     0.9278 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.3142 | Accuracy:  89.6992% | Elapsed:     4s
Validation | Loss:     0.9924 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.2971 | Accuracy:  90.6057% | Elapsed:     4s
Validation | Loss:     0.9024 | Accuracy:  73.1241% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.2944 | Accuracy:  90.7293% | Elapsed:     4s
Validation | Loss:     0.9837 | Accuracy:  73.1241% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2855 | Accuracy:  90.9353% | Elapsed:     4s
Validation | Loss:     0.9347 | Accuracy:  74.2156% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2815 | Accuracy:  91.1001% | Elapsed:     4s
Validation | Loss:     0.9016 | Accuracy:  75.5798% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.2726 | Accuracy:  91.8418% | Elapsed:     4s
Validation | Loss:     0.9517 | Accuracy:  73.8063% | Elapsed:     1s
Epoch 00064: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2540 | Accuracy:  92.1714% | Elapsed:     4s
Validation | Loss:     0.9653 | Accuracy:  74.3520% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2436 | Accuracy:  92.5834% | Elapsed:     4s
Validation | Loss:     0.9658 | Accuracy:  73.9427% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.2400 | Accuracy:  92.8719% | Elapsed:     4s
Validation | Loss:     0.9717 | Accuracy:  73.9427% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.2381 | Accuracy:  93.0779% | Elapsed:     4s
Validation | Loss:     0.9829 | Accuracy:  73.9427% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.2360 | Accuracy:  93.2427% | Elapsed:     4s
Validation | Loss:     0.9891 | Accuracy:  74.0791% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.2338 | Accuracy:  93.2015% | Elapsed:     4s
Validation | Loss:     1.0049 | Accuracy:  72.8513% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
```

```
Training   | Loss:     0.2305 | Accuracy:  93.4487% | Elapsed:     4s
Validation | Loss:     0.9756 | Accuracy:  73.6698% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.2298 | Accuracy:  93.3251% | Elapsed:     4s
Validation | Loss:     1.0011 | Accuracy:  73.9427% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.2276 | Accuracy:  93.3663% | Elapsed:     4s
Validation | Loss:     0.9950 | Accuracy:  73.8063% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.2248 | Accuracy:  93.4075% | Elapsed:     4s
Validation | Loss:     1.0242 | Accuracy:  73.2606% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.2225 | Accuracy:  93.5723% | Elapsed:     4s
Validation | Loss:     1.0243 | Accuracy:  73.6698% | Elapsed:     1s
Epoch 00075: reducing learning rate of group 0 to 1.0000e-06.
===============================================================================
Training complete in 5m 36s
Best model accuracy:  75.58%
===============================================================================
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===============================================================================
Hidden Size = 512
RNN Layers = 2
L2 Regularization Weight = 0.01
-------------------------------------------------------------------------------
RNN Model:
Network_LSTM(
  (rnn): LSTM(1629, 512, num_layers=2, batch_first=True)
  (fc): Linear(in_features=512, out_features=10, bias=False)
)
-------------------------------------------------------------------------------
Epoch 1/75
Training   | Loss:     1.9891 | Accuracy:  20.7252% | Elapsed:     4s
Validation | Loss:     2.0779 | Accuracy:  23.3288% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.8543 | Accuracy:  27.1529% | Elapsed:     4s
Validation | Loss:     1.7776 | Accuracy:  30.6958% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.6689 | Accuracy:  34.6518% | Elapsed:     4s
Validation | Loss:     1.8730 | Accuracy:  27.2851% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.5668 | Accuracy:  40.1319% | Elapsed:     4s
Validation | Loss:     1.8874 | Accuracy:  30.2865% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.6608 | Accuracy:  33.8278% | Elapsed:     4s
Validation | Loss:     1.8411 | Accuracy:  23.3288% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.6847 | Accuracy:  33.5393% | Elapsed:     4s
Validation | Loss:     1.7370 | Accuracy:  34.7885% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.5029 | Accuracy:  43.3045% | Elapsed:     4s
Validation | Loss:     1.6757 | Accuracy:  32.8786% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.4349 | Accuracy:  44.8702% | Elapsed:     4s
Validation | Loss:     1.6175 | Accuracy:  42.1555% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.3519 | Accuracy:  48.7845% | Elapsed:     4s
Validation | Loss:     1.4118 | Accuracy:  47.6126% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.3424 | Accuracy:  48.0016% | Elapsed:     4s
Validation | Loss:     1.5668 | Accuracy:  45.1569% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.4259 | Accuracy:  48.2077% | Elapsed:     4s
Validation | Loss:     1.6344 | Accuracy:  47.3397% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.3014 | Accuracy:  50.3502% | Elapsed:     4s
Validation | Loss:     1.3756 | Accuracy:  51.1596% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.2863 | Accuracy:  52.9460% | Elapsed:     4s
Validation | Loss:     1.4190 | Accuracy:  50.4775% | Elapsed:     1s
```

```
-------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.3198 | Accuracy:  50.3090% | Elapsed:     4s
Validation | Loss:     1.5591 | Accuracy:  43.7926% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.2390 | Accuracy:  53.6053% | Elapsed:     4s
Validation | Loss:     1.4541 | Accuracy:  47.7490% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.1408 | Accuracy:  59.5385% | Elapsed:     4s
Validation | Loss:     1.3482 | Accuracy:  49.6589% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.1375 | Accuracy:  59.1677% | Elapsed:     4s
Validation | Loss:     1.3008 | Accuracy:  49.2497% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.1096 | Accuracy:  60.4862% | Elapsed:     4s
Validation | Loss:     1.3237 | Accuracy:  53.0696% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.0795 | Accuracy:  62.2167% | Elapsed:     4s
Validation | Loss:     1.1860 | Accuracy:  54.7067% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.7980 | Accuracy:  33.1273% | Elapsed:     4s
Validation | Loss:     1.9526 | Accuracy:  27.6944% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.6111 | Accuracy:  39.3902% | Elapsed:     4s
Validation | Loss:     1.6855 | Accuracy:  34.7885% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.4522 | Accuracy:  45.3234% | Elapsed:     4s
Validation | Loss:     1.7034 | Accuracy:  40.5184% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.4668 | Accuracy:  45.1174% | Elapsed:     4s
Validation | Loss:     1.4627 | Accuracy:  46.9304% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.2433 | Accuracy:  53.8525% | Elapsed:     4s
Validation | Loss:     1.3161 | Accuracy:  50.3411% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.3288 | Accuracy:  51.2979% | Elapsed:     4s
Validation | Loss:     1.5119 | Accuracy:  48.9768% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.2099 | Accuracy:  56.6543% | Elapsed:     4s
Validation | Loss:     1.2684 | Accuracy:  55.3888% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.1941 | Accuracy:  58.2200% | Elapsed:     4s
Validation | Loss:     1.4147 | Accuracy:  50.3411% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     1.2176 | Accuracy:  56.8191% | Elapsed:     4s
Validation | Loss:     1.3362 | Accuracy:  56.2074% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.2306 | Accuracy:  54.3469% | Elapsed:     4s
Validation | Loss:     1.5749 | Accuracy:  39.5634% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.2718 | Accuracy:  54.7178% | Elapsed:     4s
Validation | Loss:     1.6796 | Accuracy:  38.3356% | Elapsed:     1s
Epoch 00030: reducing learning rate of group 0 to 1.0000e-04.
-------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.0201 | Accuracy:  66.4607% | Elapsed:     4s
Validation | Loss:     1.2665 | Accuracy:  54.5703% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.9454 | Accuracy:  68.7680% | Elapsed:     4s
Validation | Loss:     1.2332 | Accuracy:  57.8445% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.9063 | Accuracy:  71.1990% | Elapsed:     4s
Validation | Loss:     1.2309 | Accuracy:  56.0709% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.8888 | Accuracy:  70.5398% | Elapsed:     4s
Validation | Loss:     1.2133 | Accuracy:  57.5716% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.8677 | Accuracy:  72.2703% | Elapsed:     4s
Validation | Loss:     1.2039 | Accuracy:  57.0259% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 36/75
```

```
Training   | Loss:     0.8816 | Accuracy:  71.0754% | Elapsed:     4s
Validation | Loss:     1.1919 | Accuracy:  60.1637% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.8647 | Accuracy:  72.9295% | Elapsed:     4s
Validation | Loss:     1.1193 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.9743 | Accuracy:  66.9139% | Elapsed:     4s
Validation | Loss:     1.3258 | Accuracy:  56.0709% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.8863 | Accuracy:  70.1277% | Elapsed:     4s
Validation | Loss:     1.2137 | Accuracy:  59.6180% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.8607 | Accuracy:  70.9106% | Elapsed:     4s
Validation | Loss:     1.1904 | Accuracy:  58.2538% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.8602 | Accuracy:  71.5286% | Elapsed:     4s
Validation | Loss:     1.1771 | Accuracy:  58.7995% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.9278 | Accuracy:  68.5620% | Elapsed:     4s
Validation | Loss:     1.2079 | Accuracy:  61.3915% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.8739 | Accuracy:  70.7870% | Elapsed:     4s
Validation | Loss:     1.2942 | Accuracy:  56.3438% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.8138 | Accuracy:  73.5888% | Elapsed:     4s
Validation | Loss:     1.1914 | Accuracy:  60.1637% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.7865 | Accuracy:  74.0008% | Elapsed:     4s
Validation | Loss:     1.1570 | Accuracy:  61.2551% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.7941 | Accuracy:  74.0420% | Elapsed:     4s
Validation | Loss:     1.1717 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.7697 | Accuracy:  74.6189% | Elapsed:     4s
Validation | Loss:     1.1598 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.7727 | Accuracy:  74.4129% | Elapsed:     4s
Validation | Loss:     1.0294 | Accuracy:  62.8922% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.7554 | Accuracy:  74.9485% | Elapsed:     4s
Validation | Loss:     1.1417 | Accuracy:  61.5280% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.7508 | Accuracy:  76.3082% | Elapsed:     4s
Validation | Loss:     1.0869 | Accuracy:  63.1651% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.7447 | Accuracy:  76.7614% | Elapsed:     4s
Validation | Loss:     1.1382 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.7447 | Accuracy:  75.8550% | Elapsed:     4s
Validation | Loss:     1.1504 | Accuracy:  62.3465% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.7284 | Accuracy:  76.8026% | Elapsed:     4s
Validation | Loss:     1.1968 | Accuracy:  59.0723% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.7251 | Accuracy:  76.4730% | Elapsed:     4s
Validation | Loss:     1.0512 | Accuracy:  63.5744% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.7114 | Accuracy:  77.7915% | Elapsed:     4s
Validation | Loss:     1.0782 | Accuracy:  64.5293% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.7283 | Accuracy:  76.4730% | Elapsed:     4s
Validation | Loss:     1.1943 | Accuracy:  60.3001% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.7203 | Accuracy:  77.2147% | Elapsed:     4s
Validation | Loss:     1.1491 | Accuracy:  62.8922% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.6860 | Accuracy:  78.7804% | Elapsed:     4s
Validation | Loss:     1.1265 | Accuracy:  63.9836% | Elapsed:     1s
---------------------------------------------------------------------------
```

```
Epoch 59/75
Training   | Loss:     0.7160 | Accuracy:  76.5966% | Elapsed:     4s
Validation | Loss:     1.0864 | Accuracy:  63.9836% | Elapsed:     1s
Epoch 00059: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.6485 | Accuracy:  80.1813% | Elapsed:     4s
Validation | Loss:     1.1101 | Accuracy:  64.2565% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.6292 | Accuracy:  80.6345% | Elapsed:     4s
Validation | Loss:     1.1059 | Accuracy:  64.5293% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.6249 | Accuracy:  81.0466% | Elapsed:     4s
Validation | Loss:     1.0627 | Accuracy:  64.5293% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.6234 | Accuracy:  80.8405% | Elapsed:     4s
Validation | Loss:     1.1132 | Accuracy:  63.4379% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.6115 | Accuracy:  81.2114% | Elapsed:     4s
Validation | Loss:     1.0928 | Accuracy:  65.6207% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.6081 | Accuracy:  81.1702% | Elapsed:     4s
Validation | Loss:     1.1341 | Accuracy:  63.3015% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.6049 | Accuracy:  81.4174% | Elapsed:     4s
Validation | Loss:     1.1085 | Accuracy:  64.2565% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.6017 | Accuracy:  81.6234% | Elapsed:     4s
Validation | Loss:     1.0805 | Accuracy:  64.8022% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.5973 | Accuracy:  81.6234% | Elapsed:     4s
Validation | Loss:     1.1107 | Accuracy:  64.6658% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.5941 | Accuracy:  82.3239% | Elapsed:     4s
Validation | Loss:     1.0552 | Accuracy:  66.0300% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.5894 | Accuracy:  82.2002% | Elapsed:     4s
Validation | Loss:     1.1234 | Accuracy:  64.6658% | Elapsed:     1s
Epoch 00070: reducing learning rate of group 0 to 1.0000e-06.
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.5845 | Accuracy:  82.4063% | Elapsed:     4s
Validation | Loss:     1.1132 | Accuracy:  65.0750% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.5809 | Accuracy:  82.6123% | Elapsed:     4s
Validation | Loss:     1.1107 | Accuracy:  65.0750% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.5790 | Accuracy:  82.7771% | Elapsed:     4s
Validation | Loss:     1.1099 | Accuracy:  64.6658% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.5782 | Accuracy:  82.8595% | Elapsed:     4s
Validation | Loss:     1.1151 | Accuracy:  64.3929% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.5774 | Accuracy:  82.9007% | Elapsed:     4s
Validation | Loss:     1.1211 | Accuracy:  64.2565% | Elapsed:     1s
===========================================================================
Training complete in 5m 37s
Best model accuracy:  66.03%
===========================================================================
```

Hyper-parameter Grid Search Details

In [36]:

```
d=[]
for hp,th in trainHistoryAll:
    locBest=th[:,4].argmax()
    maxValAccuracy=float(th[locBest,4])
    valLoss=float(th[locBest,3])
    d.append([hp[0],hp[1],hp[2],valLoss,maxValAccuracy])

columns=['Hidden_Size','RNN_Layers','L2_Reg_Weight','Val_Loss','Val_Accuracy']
df = pd.DataFrame(d, columns=columns)
df
```

Out[36]: Show 10 entries

Search:

Hidden_Size	RNN_Layers	L2_Reg_Weight	Val_Loss	Val_Accuracy
128	1	0.0001	0.787221	0.762619
128	1	0.001	0.756598	0.759891
128	1	0.01	1.036203	0.712142
128	2	0.0001	0.979854	0.713506
128	2	0.001	0.899766	0.739427
128	2	0.01	1.134686	0.612551
256	1	0.0001	0.716525	0.784447
256	1	0.001	0.673652	0.796726
256	1	0.01	1.043928	0.702592
256	2	0.0001	0.936982	0.732606

Showing 1 to 10 of 18 entries

Previous 1 2 Next

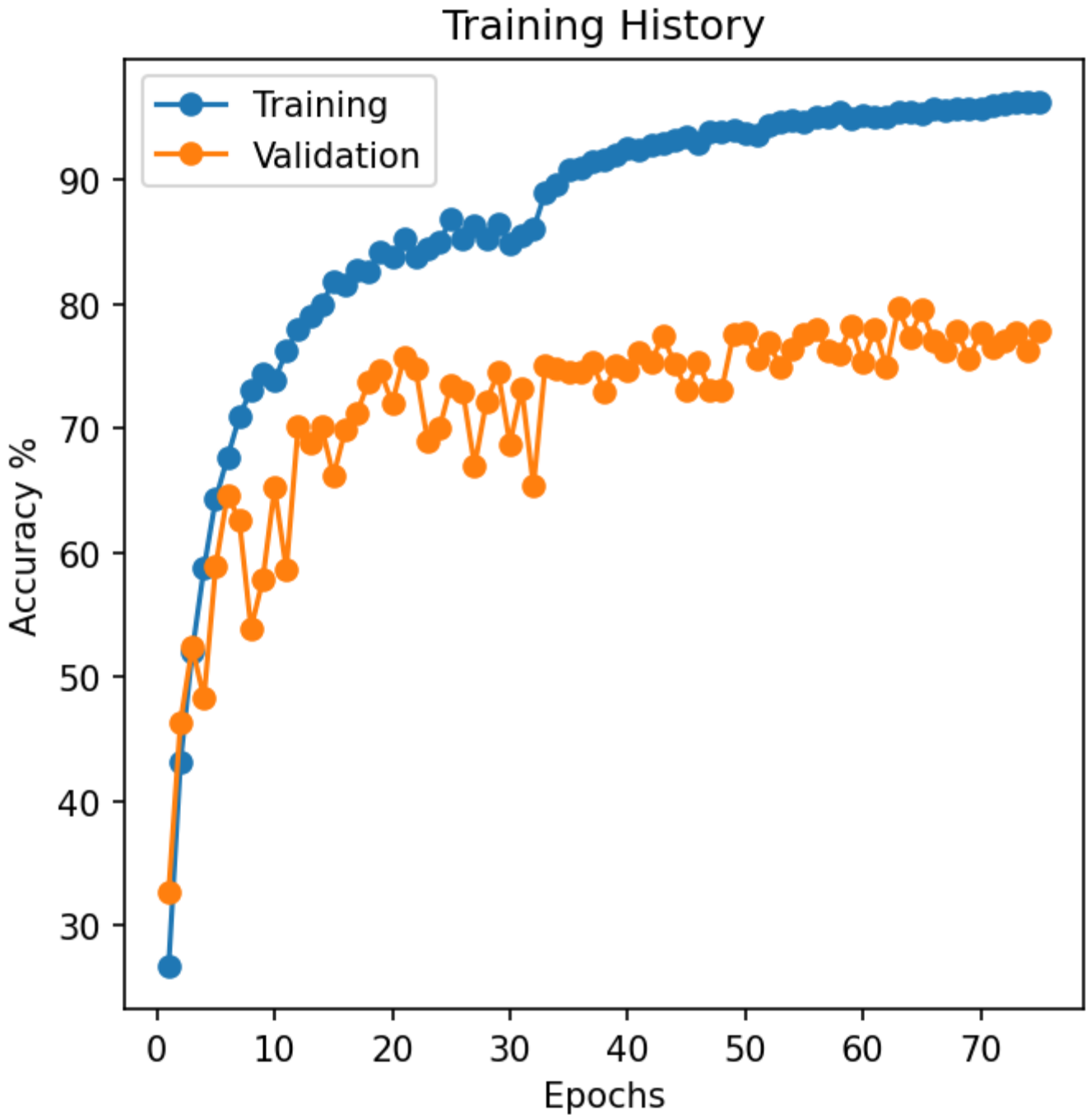
Best Trial Hyper-parameters

In [27]:
```
print("Best Trial Hyper-parameters:")
print(f'    Hidden Size = {bestModelHyperParameters[0]}')
print(f'    RNN Layers = {bestModelHyperParameters[1]}')
print(f'    L2 Regularization Weight = {bestModelHyperParameters[2]}')
```

```
Best Trial Hyper-parameters:
    Hidden Size = 256
    RNN Layers = 1
    L2 Regularization Weight = 0.001
```

Best Trial Training Accuracy History

In [22]:
```
figure = plt.figure(figsize=(5, 5),dpi=150)
plt.plot(range(1,bestModelTrainHistory.size(0)+1), bestModelTrainHistory[:,[1,4]]*100.0,"o-")
plt.legend(["Training","Validation"])
plt.title("Training History")
plt.xlabel("Epochs")
plt.ylabel("Accuracy %")
plt.show()
```



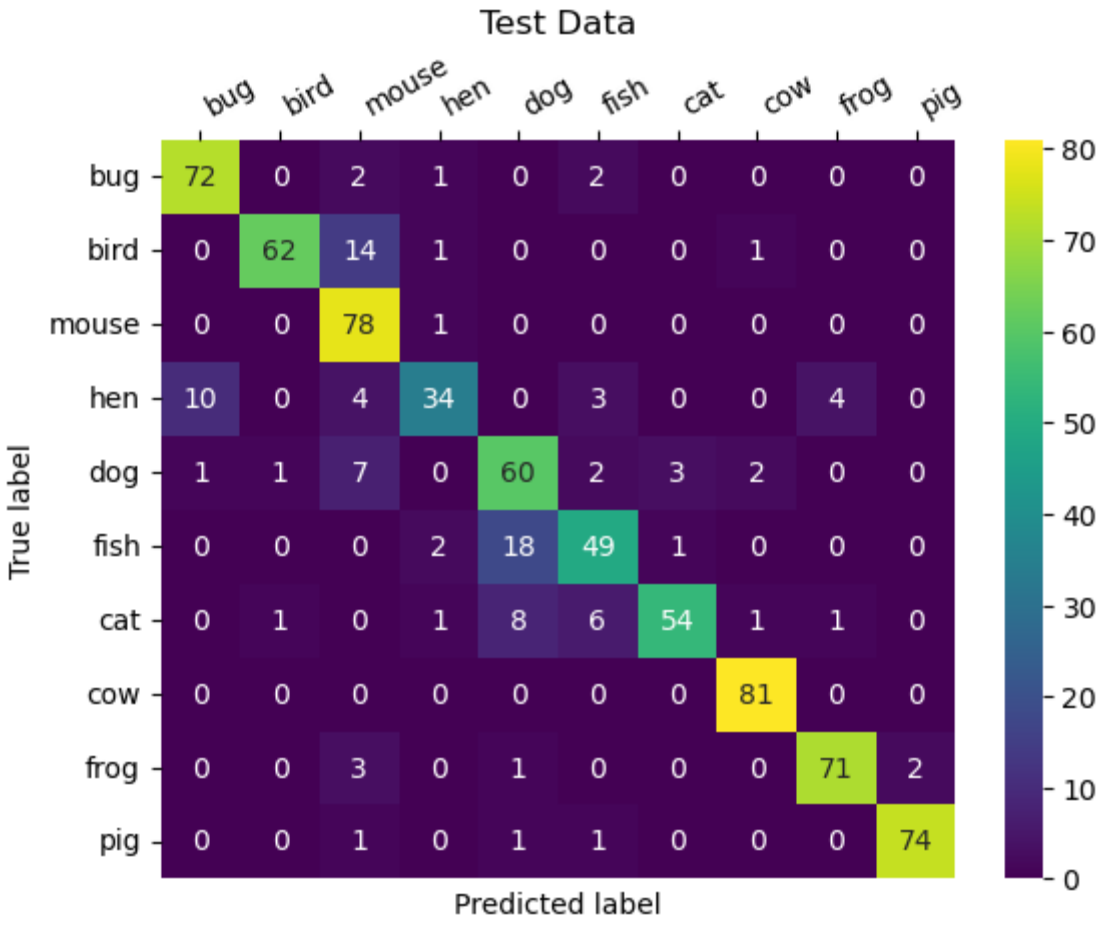
Best Trial Test Accuracy

In [23]:
```
bestModel.eval()
testLoss = 0
testTruePositives = 0
testN=0
predicted=[]
actual=[]
for inputs, targets in testDataloader:
    inputs = inputs.to(device)
    targets = targets.to(device)

    with torch.set_grad_enabled(False):
        modelOutputs = bestModel(inputs)
        predictedClass = torch.max(modelOutputs, 1)[1]
        loss = torch.nn.CrossEntropyLoss()(modelOutputs, torch.max(targets,1)[1])
    testLoss += loss.item() * len(targets)
    testN += len(targets)
    predicted+=predictedClass.tolist()
    actual+=torch.max(targets,1)[1].tolist()
    testTruePositives += torch.sum(predictedClass == torch.max(targets,1)[1])

testLoss /= testN
testAccuracy = testTruePositives.double() / testN

print(f'Test Data | Loss: {testLoss:10.4f} Accuracy: {testAccuracy*100:10.4f}%')
```

```
Test Data | Loss:     0.4544 Accuracy:    85.5795%
```

Best Trial Test Confusion Matrix

In [24]:
```
CM=confusion_matrix(actual, predicted)
class_names=[k for k in target_id_map.keys()]
df_cm = pd.DataFrame(CM, index=class_names, columns=class_names).astype(int)
heatmap = sns.heatmap(df_cm, annot=True, fmt="d", cmap='viridis')

heatmap.yaxis.set_ticklabels(heatmap.yaxis.get_ticklabels(), rotation=0, ha='right')
heatmap.xaxis.set_ticklabels(heatmap.xaxis.get_ticklabels(), rotation=30, ha='left')
heatmap.xaxis.tick_top()
plt.ylabel('True label')
plt.xlabel('Predicted label')
plt.title("Test Data")
plt.show()
```


Test Data
bug
bird
mouse
hen
dog
fish
cat
cow
frog
pig
True label
Predicted label
72 0 2 1 0 2 0 0 0 0
0 62 14 1 0 0 0 1 0 0
0 0 78 1 0 0 0 0 0 0
10 0 4 34 0 3 0 0 4 0
1 1 7 0 60 2 3 2 0 0
0 0 0 2 18 49 1 0 0 0
0 1 0 1 8 6 54 1 1 0
0 0 0 0 0 0 0 81 0 0
0 0 3 0 1 0 0 0 71 2
0 0 1 0 1 1 0 0 0 74
80
70
60
50
40
30
20
10
0