Google Isolated Sign Language Recognition

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

Team Members: Vikky Masih, Pallapu Mohan Krishna, Shania H, Rahul Bhardwaj, Prakhar Kumar Sonkar

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 [3]:
```
# itable_opt.maxBytes=512*1024
init_notebook_mode(all_interactive=True)
```

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
Sat May 13 23:46:22 2023
+---------------------------------------------------------------------------------------+
| NVIDIA-SMI 531.61                 Driver Version: 531.61       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%   34C    P8               18W / 450W|   1713MiB / 24564MiB |      0%      Default |
|                                         |                      |                  N/A |
+-----------------------------------------+----------------------+----------------------+

+---------------------------------------------------------------------------------------+
| Processes:                                                                            |
|  GPU   GI   CI        PID   Type   Process name                            GPU Memory |
|        ID   ID                                                             Usage      |
|=======================================================================================|
|    0   N/A  N/A      8676      C   C:\anaconda3\python.exe                    N/A      |
|    0   N/A  N/A      9700    C+G   C:\Windows\explorer.exe                    N/A      |
|    0   N/A  N/A      9768    C+G   ...es\Windows Firewall Control\wfc.exe    N/A      |
|    0   N/A  N/A     10268    C+G   ...nt.CBS_cw5n1h2txyewy\SearchHost.exe    N/A      |
|    0   N/A  N/A     10292    C+G   ...2txyewy\StartMenuExperienceHost.exe    N/A      |
|    0   N/A  N/A     12680    C+G   ...siveControlPanel\SystemSettings.exe    N/A      |
|    0   N/A  N/A     13444    C+G   ...t.LockApp_cw5n1h2txyewy\LockApp.exe    N/A      |
|    0   N/A  N/A     13768    C+G   ...5n1h2txyewy\ShellExperienceHost.exe    N/A      |
|    0   N/A  N/A     14420    C+G   ...crosoft\Edge\Application\msedge.exe    N/A      |
|    0   N/A  N/A     15868    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 [7]:
```
# 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[7]: 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 [8]:
```
pd.read_parquet(os.path.join(myDataDir,T.path[0]))
```

Out[8]: 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, 14878.90it/s]

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

Target and Group IDs

In [14]:
```
targets=T.loc[:,"sign"].to_list()
uniqueTarget=list(set(targets))
uniqueTarget.sort()
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))
uniqueGroup.sort()
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],\
                    'ClassNames':uniqueTarget,\
                    '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:     1.9894 | Accuracy:  26.3288% | Elapsed:    13s
Validation | Loss:     1.9640 | Accuracy:  27.0123% | Elapsed:     4s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6651 | Accuracy:  45.6119% | Elapsed:     4s
Validation | Loss:     1.6460 | Accuracy:  42.1555% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4488 | Accuracy:  53.1520% | Elapsed:     4s
Validation | Loss:     1.5868 | Accuracy:  48.4311% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2925 | Accuracy:  58.6733% | Elapsed:     4s
Validation | Loss:     1.4586 | Accuracy:  51.0232% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1452 | Accuracy:  64.5241% | Elapsed:     4s
Validation | Loss:     1.5177 | Accuracy:  44.8840% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.0558 | Accuracy:  67.8616% | Elapsed:     4s
Validation | Loss:     1.2900 | Accuracy:  57.1623% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.9591 | Accuracy:  72.4763% | Elapsed:     4s
Validation | Loss:     1.1214 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.8977 | Accuracy:  74.1244% | Elapsed:     4s
Validation | Loss:     1.0989 | Accuracy:  60.9823% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.8256 | Accuracy:  75.8138% | Elapsed:     4s
Validation | Loss:     1.1592 | Accuracy:  58.7995% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8047 | Accuracy:  76.4318% | Elapsed:     4s
Validation | Loss:     1.0508 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.7732 | Accuracy:  77.3795% | Elapsed:     4s
Validation | Loss:     1.1320 | Accuracy:  62.0737% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.7376 | Accuracy:  79.1100% | Elapsed:     4s
Validation | Loss:     1.0676 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.6946 | Accuracy:  80.1401% | Elapsed:     4s
Validation | Loss:     1.1882 | Accuracy:  59.6180% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.6700 | Accuracy:  80.8405% | Elapsed:     4s
Validation | Loss:     1.0202 | Accuracy:  67.6671% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.6451 | Accuracy:  81.7058% | Elapsed:     4s
Validation | Loss:     0.9873 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.6366 | Accuracy:  82.1590% | Elapsed:     4s
Validation | Loss:     1.1151 | Accuracy:  62.7558% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.6024 | Accuracy:  83.8072% | Elapsed:     4s
Validation | Loss:     1.0862 | Accuracy:  65.6207% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.5747 | Accuracy:  84.2604% | Elapsed:     4s
Validation | Loss:     0.9036 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.5972 | Accuracy:  82.6123% | Elapsed:     4s
```

```
Validation | Loss:     0.9247 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.5619 | Accuracy:  84.3016% | Elapsed:     4s
Validation | Loss:     0.9824 | Accuracy:  68.7585% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.5432 | Accuracy:  84.5076% | Elapsed:     4s
Validation | Loss:     0.9783 | Accuracy:  68.3492% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.5383 | Accuracy:  84.7548% | Elapsed:     4s
Validation | Loss:     0.9859 | Accuracy:  68.0764% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.5364 | Accuracy:  85.7849% | Elapsed:     4s
Validation | Loss:     0.9353 | Accuracy:  70.1228% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.5107 | Accuracy:  86.1557% | Elapsed:     4s
Validation | Loss:     0.8639 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.4960 | Accuracy:  85.9497% | Elapsed:     4s
Validation | Loss:     0.7779 | Accuracy:  73.9427% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.4652 | Accuracy:  86.5266% | Elapsed:     4s
Validation | Loss:     1.0144 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.4549 | Accuracy:  86.5678% | Elapsed:     4s
Validation | Loss:     0.9652 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.4766 | Accuracy:  85.6613% | Elapsed:     4s
Validation | Loss:     0.7947 | Accuracy:  73.6698% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.4634 | Accuracy:  86.3618% | Elapsed:     4s
Validation | Loss:     0.8777 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.4490 | Accuracy:  86.6914% | Elapsed:     4s
Validation | Loss:     0.9345 | Accuracy:  68.6221% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.4192 | Accuracy:  88.0923% | Elapsed:     4s
Validation | Loss:     0.8697 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.4063 | Accuracy:  88.3395% | Elapsed:     4s
Validation | Loss:     0.9946 | Accuracy:  67.2578% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.3953 | Accuracy:  88.5043% | Elapsed:     4s
Validation | Loss:     0.9171 | Accuracy:  69.8499% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.4052 | Accuracy:  87.9275% | Elapsed:     4s
Validation | Loss:     0.9495 | Accuracy:  68.0764% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.3854 | Accuracy:  88.7515% | Elapsed:     4s
Validation | Loss:     0.8280 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.3800 | Accuracy:  88.8752% | Elapsed:     4s
Validation | Loss:     0.9864 | Accuracy:  67.1214% | Elapsed:     1s
Epoch 00036: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.2963 | Accuracy:  92.0478% | Elapsed:     4s
Validation | Loss:     0.8531 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.2777 | Accuracy:  93.1191% | Elapsed:     4s
Validation | Loss:     0.8382 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.2746 | Accuracy:  92.9955% | Elapsed:     4s
Validation | Loss:     0.9017 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.2719 | Accuracy:  93.2015% | Elapsed:     4s
Validation | Loss:     0.8481 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.2675 | Accuracy:  93.4075% | Elapsed:     4s
Validation | Loss:     0.8505 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 42/75
Training   | Loss:     0.2646 | Accuracy:  93.3251% | Elapsed:     4s
Validation | Loss:     0.8559 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.2614 | Accuracy:  93.3251% | Elapsed:     4s
Validation | Loss:     0.8751 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2594 | Accuracy:  93.5311% | Elapsed:     4s
Validation | Loss:     0.8489 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2543 | Accuracy:  93.7783% | Elapsed:     4s
Validation | Loss:     0.8069 | Accuracy:  73.1241% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2522 | Accuracy:  93.8195% | Elapsed:     4s
Validation | Loss:     0.8359 | Accuracy:  73.8063% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2489 | Accuracy:  93.9843% | Elapsed:     4s
Validation | Loss:     0.8292 | Accuracy:  73.5334% | Elapsed:     1s
Epoch 00047: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2383 | Accuracy:  94.3552% | Elapsed:     4s
Validation | Loss:     0.8367 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2362 | Accuracy:  94.2728% | Elapsed:     4s
Validation | Loss:     0.8461 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2354 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8459 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2343 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     0.8394 | Accuracy:  72.3056% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2337 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8368 | Accuracy:  72.8513% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2331 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8392 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2325 | Accuracy:  94.4376% | Elapsed:     4s
Validation | Loss:     0.8377 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.2318 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     0.8421 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.2313 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     0.8366 | Accuracy:  72.8513% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.2308 | Accuracy:  94.3964% | Elapsed:     4s
Validation | Loss:     0.8367 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.2303 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     0.8355 | Accuracy:  72.7149% | Elapsed:     1s
Epoch 00058: reducing learning rate of group 0 to 1.0000e-06.
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.2284 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8360 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.2283 | Accuracy:  94.4788% | Elapsed:     3s
Validation | Loss:     0.8360 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.2283 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8361 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2282 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8361 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2281 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.8366 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
```

```
Training   | Loss:     0.2280 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.8366 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2280 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.8365 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2279 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.8364 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.2279 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.8363 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.2278 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.8364 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.2277 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     0.8362 | Accuracy:  72.4420% | Elapsed:     1s
Epoch 00069: reducing learning rate of group 0 to 1.0000e-07.
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.2275 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     0.8362 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.2275 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.8362 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.2275 | Accuracy:  94.5200% | Elapsed:     3s
Validation | Loss:     0.8363 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.2275 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     0.8362 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.2275 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     0.8362 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.2275 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     0.8362 | Accuracy:  72.4420% | Elapsed:     1s
===========================================================================
Training complete in 5m 42s
Best model accuracy:  73.94%
===========================================================================
|
|
|
|
|

===========================================================================
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:     1.9808 | Accuracy:  29.1306% | Elapsed:     4s
Validation | Loss:     1.9080 | Accuracy:  30.4229% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6656 | Accuracy:  43.0573% | Elapsed:     4s
Validation | Loss:     1.7282 | Accuracy:  42.9741% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4632 | Accuracy:  51.8747% | Elapsed:     4s
Validation | Loss:     1.6330 | Accuracy:  46.9304% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2741 | Accuracy:  58.5909% | Elapsed:     4s
Validation | Loss:     1.4341 | Accuracy:  51.1596% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1801 | Accuracy:  62.6288% | Elapsed:     4s
Validation | Loss:     1.3932 | Accuracy:  53.8881% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.1193 | Accuracy:  64.6889% | Elapsed:     4s
Validation | Loss:     1.3647 | Accuracy:  53.0696% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.0339 | Accuracy:  68.3972% | Elapsed:     4s
Validation | Loss:     1.3327 | Accuracy:  52.2510% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9925 | Accuracy:  69.5097% | Elapsed:     4s
Validation | Loss:     1.3723 | Accuracy:  52.6603% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.9757 | Accuracy:  69.1801% | Elapsed:     4s
Validation | Loss:     1.2183 | Accuracy:  58.2538% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.9053 | Accuracy:  72.1467% | Elapsed:     4s
Validation | Loss:     1.1715 | Accuracy:  62.2101% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.8893 | Accuracy:  72.5175% | Elapsed:     4s
Validation | Loss:     1.1359 | Accuracy:  60.8458% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.8137 | Accuracy:  75.3605% | Elapsed:     4s
Validation | Loss:     1.2861 | Accuracy:  55.5252% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.8383 | Accuracy:  74.4541% | Elapsed:     4s
Validation | Loss:     1.1816 | Accuracy:  60.8458% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.8003 | Accuracy:  76.6378% | Elapsed:     3s
Validation | Loss:     1.1147 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.7797 | Accuracy:  77.0087% | Elapsed:     3s
Validation | Loss:     1.1351 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.7558 | Accuracy:  77.5031% | Elapsed:     3s
Validation | Loss:     0.9983 | Accuracy:  66.8486% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.7365 | Accuracy:  78.2035% | Elapsed:     3s
Validation | Loss:     1.0599 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.7243 | Accuracy:  79.2336% | Elapsed:     3s
Validation | Loss:     1.1387 | Accuracy:  61.8008% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.6961 | Accuracy:  79.3160% | Elapsed:     4s
Validation | Loss:     0.9252 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.6855 | Accuracy:  79.9341% | Elapsed:     4s
Validation | Loss:     1.0587 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.6856 | Accuracy:  79.3572% | Elapsed:     4s
Validation | Loss:     1.0133 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.6482 | Accuracy:  81.2938% | Elapsed:     4s
Validation | Loss:     0.8890 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6471 | Accuracy:  81.4174% | Elapsed:     4s
Validation | Loss:     1.0003 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.6333 | Accuracy:  81.8294% | Elapsed:     4s
Validation | Loss:     0.9725 | Accuracy:  68.2128% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5924 | Accuracy:  82.6535% | Elapsed:     4s
Validation | Loss:     0.9064 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.6199 | Accuracy:  81.5410% | Elapsed:     4s
Validation | Loss:     0.9427 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5891 | Accuracy:  82.9831% | Elapsed:     4s
Validation | Loss:     0.8643 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.5974 | Accuracy:  82.3651% | Elapsed:     4s
Validation | Loss:     0.9744 | Accuracy:  66.4393% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.6236 | Accuracy:  81.9530% | Elapsed:     4s
```

```
Validation | Loss:     0.9694 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.5720 | Accuracy:  83.9308% | Elapsed:     3s
Validation | Loss:     0.9060 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.5583 | Accuracy:  84.9609% | Elapsed:     4s
Validation | Loss:     0.9675 | Accuracy:  69.5771% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.5372 | Accuracy:  84.8785% | Elapsed:     4s
Validation | Loss:     0.8676 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.5291 | Accuracy:  85.4141% | Elapsed:     4s
Validation | Loss:     0.8178 | Accuracy:  75.0341% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.5240 | Accuracy:  85.8261% | Elapsed:     4s
Validation | Loss:     0.8332 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.5196 | Accuracy:  86.0733% | Elapsed:     4s
Validation | Loss:     0.8312 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.5264 | Accuracy:  85.4553% | Elapsed:     4s
Validation | Loss:     0.8790 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.5442 | Accuracy:  84.4664% | Elapsed:     4s
Validation | Loss:     0.8444 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.5214 | Accuracy:  85.3729% | Elapsed:     4s
Validation | Loss:     0.9371 | Accuracy:  67.5307% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.5109 | Accuracy:  85.9085% | Elapsed:     4s
Validation | Loss:     0.7629 | Accuracy:  75.1705% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.4751 | Accuracy:  86.6502% | Elapsed:     4s
Validation | Loss:     0.9600 | Accuracy:  67.2578% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.4725 | Accuracy:  86.8150% | Elapsed:     4s
Validation | Loss:     0.8642 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.4747 | Accuracy:  87.1034% | Elapsed:     4s
Validation | Loss:     0.7756 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.4757 | Accuracy:  86.2794% | Elapsed:     4s
Validation | Loss:     0.7604 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.4968 | Accuracy:  85.4141% | Elapsed:     4s
Validation | Loss:     0.7239 | Accuracy:  77.8990% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.4929 | Accuracy:  85.9909% | Elapsed:     4s
Validation | Loss:     0.9137 | Accuracy:  67.2578% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.4876 | Accuracy:  86.9386% | Elapsed:     3s
Validation | Loss:     0.9168 | Accuracy:  67.5307% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.5693 | Accuracy:  83.5187% | Elapsed:     3s
Validation | Loss:     0.8892 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.5577 | Accuracy:  83.0655% | Elapsed:     4s
Validation | Loss:     0.7963 | Accuracy:  75.3070% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.5334 | Accuracy:  83.7660% | Elapsed:     3s
Validation | Loss:     0.8473 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.5279 | Accuracy:  84.6724% | Elapsed:     4s
Validation | Loss:     0.8418 | Accuracy:  70.5321% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.5209 | Accuracy:  84.7136% | Elapsed:     3s
Validation | Loss:     0.8856 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
```

```
Training   | Loss:     0.5178 | Accuracy:  85.6201% | Elapsed:     3s
Validation | Loss:     0.8256 | Accuracy:  71.8963% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.5048 | Accuracy:  85.2493% | Elapsed:     4s
Validation | Loss:     0.8960 | Accuracy:  69.0314% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.4976 | Accuracy:  85.5377% | Elapsed:     4s
Validation | Loss:     0.7712 | Accuracy:  75.3070% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.4795 | Accuracy:  86.7738% | Elapsed:     4s
Validation | Loss:     0.7659 | Accuracy:  75.3070% | Elapsed:     1s
Epoch 00055: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.3927 | Accuracy:  90.0288% | Elapsed:     4s
Validation | Loss:     0.7822 | Accuracy:  75.4434% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.3796 | Accuracy:  90.6881% | Elapsed:     3s
Validation | Loss:     0.7554 | Accuracy:  74.6248% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.3872 | Accuracy:  90.5645% | Elapsed:     3s
Validation | Loss:     0.7528 | Accuracy:  76.5348% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.3807 | Accuracy:  91.1413% | Elapsed:     3s
Validation | Loss:     0.7400 | Accuracy:  76.5348% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.3714 | Accuracy:  91.1001% | Elapsed:     4s
Validation | Loss:     0.7647 | Accuracy:  75.0341% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.3670 | Accuracy:  91.1825% | Elapsed:     4s
Validation | Loss:     0.7348 | Accuracy:  76.6712% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.3634 | Accuracy:  91.4710% | Elapsed:     4s
Validation | Loss:     0.7693 | Accuracy:  75.5798% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.3596 | Accuracy:  91.0589% | Elapsed:     4s
Validation | Loss:     0.7298 | Accuracy:  77.4898% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.3557 | Accuracy:  91.4297% | Elapsed:     4s
Validation | Loss:     0.7176 | Accuracy:  76.8076% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.3510 | Accuracy:  92.0478% | Elapsed:     4s
Validation | Loss:     0.7647 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.3442 | Accuracy:  91.9654% | Elapsed:     4s
Validation | Loss:     0.7322 | Accuracy:  76.3984% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.3406 | Accuracy:  91.9242% | Elapsed:     4s
Validation | Loss:     0.7140 | Accuracy:  76.3984% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.3334 | Accuracy:  92.7482% | Elapsed:     4s
Validation | Loss:     0.7616 | Accuracy:  75.1705% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.3384 | Accuracy:  92.0890% | Elapsed:     4s
Validation | Loss:     0.7259 | Accuracy:  76.6712% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.3320 | Accuracy:  92.1302% | Elapsed:     4s
Validation | Loss:     0.7590 | Accuracy:  75.1705% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.3273 | Accuracy:  92.5834% | Elapsed:     4s
Validation | Loss:     0.7415 | Accuracy:  76.5348% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.3275 | Accuracy:  92.3774% | Elapsed:     4s
Validation | Loss:     0.7255 | Accuracy:  76.8076% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.3232 | Accuracy:  92.8719% | Elapsed:     4s
Validation | Loss:     0.7148 | Accuracy:  76.8076% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.3189 | Accuracy:  92.7482% | Elapsed:     3s
Validation | Loss:     0.7151 | Accuracy:  75.9891% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.3115 | Accuracy:  92.8307% | Elapsed:     4s
Validation | Loss:     0.7272 | Accuracy:  76.6712% | Elapsed:     1s
================================================================================
Training complete in 5m 18s
Best model accuracy:  77.90%
================================================================================
|
|
|
|
|

================================================================================
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:     2.0061 | Accuracy:  26.0404% | Elapsed:     4s
Validation | Loss:     1.9404 | Accuracy:  27.9673% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.8067 | Accuracy:  35.9291% | Elapsed:     4s
Validation | Loss:     1.8177 | Accuracy:  39.1542% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.6475 | Accuracy:  42.2332% | Elapsed:     4s
Validation | Loss:     1.7263 | Accuracy:  45.4297% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.5718 | Accuracy:  44.7466% | Elapsed:     4s
Validation | Loss:     1.6480 | Accuracy:  41.3370% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.5206 | Accuracy:  48.3313% | Elapsed:     4s
Validation | Loss:     1.6500 | Accuracy:  45.8390% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.4658 | Accuracy:  51.0919% | Elapsed:     4s
Validation | Loss:     1.6008 | Accuracy:  45.1569% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.4221 | Accuracy:  53.7289% | Elapsed:     4s
Validation | Loss:     1.6374 | Accuracy:  39.8363% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.4054 | Accuracy:  53.4817% | Elapsed:     3s
Validation | Loss:     1.5512 | Accuracy:  44.6112% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.3242 | Accuracy:  56.6131% | Elapsed:     3s
Validation | Loss:     1.5283 | Accuracy:  48.4311% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.3159 | Accuracy:  56.1599% | Elapsed:     3s
Validation | Loss:     1.6098 | Accuracy:  45.8390% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.3316 | Accuracy:  56.8603% | Elapsed:     3s
Validation | Loss:     1.6020 | Accuracy:  45.7026% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.3180 | Accuracy:  57.8080% | Elapsed:     3s
Validation | Loss:     1.4927 | Accuracy:  48.1583% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.2717 | Accuracy:  59.6621% | Elapsed:     3s
Validation | Loss:     1.5146 | Accuracy:  46.1119% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.2657 | Accuracy:  59.1677% | Elapsed:     3s
Validation | Loss:     1.5847 | Accuracy:  48.5675% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.2490 | Accuracy:  61.3103% | Elapsed:     4s
Validation | Loss:     1.5233 | Accuracy:  52.3874% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.2444 | Accuracy:  60.9806% | Elapsed:     4s
Validation | Loss:     1.4347 | Accuracy:  55.7981% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.1988 | Accuracy:  62.0931% | Elapsed:     3s
```

```
Validation | Loss:     1.4057 | Accuracy:  55.5252% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.1690 | Accuracy:  63.5352% | Elapsed:     4s
Validation | Loss:     1.4464 | Accuracy:  53.4789% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.1417 | Accuracy:  64.4417% | Elapsed:     3s
Validation | Loss:     1.4246 | Accuracy:  55.2524% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.1355 | Accuracy:  64.8949% | Elapsed:     3s
Validation | Loss:     1.3207 | Accuracy:  57.0259% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.1083 | Accuracy:  65.9250% | Elapsed:     3s
Validation | Loss:     1.3339 | Accuracy:  57.9809% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.0986 | Accuracy:  66.8315% | Elapsed:     3s
Validation | Loss:     1.3405 | Accuracy:  56.7531% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.1385 | Accuracy:  64.9361% | Elapsed:     4s
Validation | Loss:     1.4017 | Accuracy:  54.4338% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.1203 | Accuracy:  66.9551% | Elapsed:     4s
Validation | Loss:     1.2542 | Accuracy:  56.7531% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.1137 | Accuracy:  65.8426% | Elapsed:     4s
Validation | Loss:     1.3627 | Accuracy:  55.1160% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.0828 | Accuracy:  69.2213% | Elapsed:     3s
Validation | Loss:     1.3497 | Accuracy:  56.4802% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.0754 | Accuracy:  68.3972% | Elapsed:     3s
Validation | Loss:     1.3215 | Accuracy:  56.7531% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     1.0762 | Accuracy:  67.9852% | Elapsed:     3s
Validation | Loss:     1.2540 | Accuracy:  59.6180% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.0740 | Accuracy:  68.0676% | Elapsed:     4s
Validation | Loss:     1.2890 | Accuracy:  58.6630% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.0863 | Accuracy:  68.7680% | Elapsed:     3s
Validation | Loss:     1.3171 | Accuracy:  52.9332% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.0763 | Accuracy:  68.3148% | Elapsed:     4s
Validation | Loss:     1.2658 | Accuracy:  62.3465% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     1.0887 | Accuracy:  67.4907% | Elapsed:     4s
Validation | Loss:     1.3000 | Accuracy:  57.9809% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     1.0642 | Accuracy:  69.6333% | Elapsed:     4s
Validation | Loss:     1.2968 | Accuracy:  53.3424% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     1.0416 | Accuracy:  70.7458% | Elapsed:     4s
Validation | Loss:     1.4673 | Accuracy:  47.8854% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.0521 | Accuracy:  70.3337% | Elapsed:     4s
Validation | Loss:     1.3403 | Accuracy:  57.7080% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     1.0174 | Accuracy:  71.5286% | Elapsed:     4s
Validation | Loss:     1.2538 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     1.0062 | Accuracy:  71.1990% | Elapsed:     4s
Validation | Loss:     1.2557 | Accuracy:  59.0723% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     1.0101 | Accuracy:  71.9819% | Elapsed:     4s
Validation | Loss:     1.3447 | Accuracy:  50.6139% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     1.0043 | Accuracy:  72.6823% | Elapsed:     4s
Validation | Loss:     1.2651 | Accuracy:  60.4366% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
```

```
Training   | Loss:     1.0087 | Accuracy:  70.7870% | Elapsed:     3s
Validation | Loss:     1.1915 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     1.0141 | Accuracy:  71.4050% | Elapsed:     4s
Validation | Loss:     1.2086 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.9959 | Accuracy:  73.0119% | Elapsed:     4s
Validation | Loss:     1.2518 | Accuracy:  58.7995% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     1.0209 | Accuracy:  72.4351% | Elapsed:     4s
Validation | Loss:     1.3052 | Accuracy:  56.0709% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     1.0244 | Accuracy:  72.5587% | Elapsed:     4s
Validation | Loss:     1.2367 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9884 | Accuracy:  72.6411% | Elapsed:     4s
Validation | Loss:     1.2635 | Accuracy:  57.8445% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.9758 | Accuracy:  73.0119% | Elapsed:     4s
Validation | Loss:     1.2036 | Accuracy:  63.0286% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.9788 | Accuracy:  72.7647% | Elapsed:     3s
Validation | Loss:     1.1702 | Accuracy:  62.8922% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     1.0291 | Accuracy:  70.8282% | Elapsed:     4s
Validation | Loss:     1.2350 | Accuracy:  58.7995% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     1.0041 | Accuracy:  71.2402% | Elapsed:     4s
Validation | Loss:     1.2032 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.9677 | Accuracy:  73.1356% | Elapsed:     3s
Validation | Loss:     1.1741 | Accuracy:  63.8472% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.9643 | Accuracy:  73.9596% | Elapsed:     4s
Validation | Loss:     1.1628 | Accuracy:  62.4829% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     1.0015 | Accuracy:  73.5476% | Elapsed:     3s
Validation | Loss:     1.2162 | Accuracy:  61.3915% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     1.0069 | Accuracy:  73.7948% | Elapsed:     3s
Validation | Loss:     1.1921 | Accuracy:  63.4379% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     1.0034 | Accuracy:  74.2480% | Elapsed:     3s
Validation | Loss:     1.2286 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     1.0105 | Accuracy:  73.9184% | Elapsed:     3s
Validation | Loss:     1.2196 | Accuracy:  62.8922% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.9947 | Accuracy:  73.2592% | Elapsed:     3s
Validation | Loss:     1.1276 | Accuracy:  69.8499% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.9673 | Accuracy:  74.5777% | Elapsed:     3s
Validation | Loss:     1.1253 | Accuracy:  67.1214% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.9806 | Accuracy:  74.1656% | Elapsed:     3s
Validation | Loss:     1.2687 | Accuracy:  61.5280% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.9807 | Accuracy:  74.5365% | Elapsed:     3s
Validation | Loss:     1.1594 | Accuracy:  63.7108% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.9509 | Accuracy:  74.9073% | Elapsed:     3s
Validation | Loss:     1.1434 | Accuracy:  66.3029% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.9648 | Accuracy:  74.8661% | Elapsed:     3s
Validation | Loss:     1.2702 | Accuracy:  60.8458% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.9972 | Accuracy:  72.9707% | Elapsed:     3s
Validation | Loss:     1.1157 | Accuracy:  66.7121% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 63/75
Training   | Loss:     0.9961 | Accuracy:  73.6712% | Elapsed:     4s
Validation | Loss:     1.1327 | Accuracy:  67.8035% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.9772 | Accuracy:  73.0944% | Elapsed:     4s
Validation | Loss:     1.1696 | Accuracy:  62.8922% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.9789 | Accuracy:  73.0532% | Elapsed:     4s
Validation | Loss:     1.1315 | Accuracy:  68.2128% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.9731 | Accuracy:  74.4953% | Elapsed:     3s
Validation | Loss:     1.2406 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.9486 | Accuracy:  75.8962% | Elapsed:     3s
Validation | Loss:     1.1195 | Accuracy:  67.3943% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.9486 | Accuracy:  75.2369% | Elapsed:     4s
Validation | Loss:     1.0996 | Accuracy:  65.0750% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.9378 | Accuracy:  75.8138% | Elapsed:     4s
Validation | Loss:     1.1412 | Accuracy:  65.3479% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.9769 | Accuracy:  72.5999% | Elapsed:     4s
Validation | Loss:     1.2654 | Accuracy:  59.2087% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.9727 | Accuracy:  72.3115% | Elapsed:     4s
Validation | Loss:     1.1509 | Accuracy:  66.5757% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.9325 | Accuracy:  76.0198% | Elapsed:     3s
Validation | Loss:     1.0818 | Accuracy:  67.8035% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.9582 | Accuracy:  74.9485% | Elapsed:     4s
Validation | Loss:     1.0779 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.9508 | Accuracy:  75.2781% | Elapsed:     4s
Validation | Loss:     1.0772 | Accuracy:  69.0314% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.9180 | Accuracy:  77.1735% | Elapsed:     4s
Validation | Loss:     1.0620 | Accuracy:  71.0778% | Elapsed:     1s
===========================================================================
Training complete in 5m 10s
Best model accuracy:  71.08%
===========================================================================
|
|
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|
|

===========================================================================
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:     1.8566 | Accuracy:  28.6774% | Elapsed:     4s
Validation | Loss:     1.8097 | Accuracy:  34.6521% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5836 | Accuracy:  39.5138% | Elapsed:     4s
Validation | Loss:     1.5826 | Accuracy:  40.1091% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4470 | Accuracy:  45.6531% | Elapsed:     4s
Validation | Loss:     1.6045 | Accuracy:  45.1569% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.3110 | Accuracy:  49.0317% | Elapsed:     4s
Validation | Loss:     1.5107 | Accuracy:  46.6576% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.2418 | Accuracy:  54.1821% | Elapsed:     4s
Validation | Loss:     1.4038 | Accuracy:  51.4325% | Elapsed:     1s
```

```
-------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.2515 | Accuracy:  52.9872% | Elapsed:     4s
Validation | Loss:     1.5847 | Accuracy:  45.4297% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.1510 | Accuracy:  56.8603% | Elapsed:     4s
Validation | Loss:     1.3316 | Accuracy:  54.0246% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.0307 | Accuracy:  62.0107% | Elapsed:     4s
Validation | Loss:     1.2235 | Accuracy:  56.0709% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.0429 | Accuracy:  63.0408% | Elapsed:     4s
Validation | Loss:     1.2023 | Accuracy:  55.3888% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.9031 | Accuracy:  67.4083% | Elapsed:     4s
Validation | Loss:     1.5651 | Accuracy:  40.7913% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.0259 | Accuracy:  64.6889% | Elapsed:     3s
Validation | Loss:     1.1667 | Accuracy:  58.1173% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.9719 | Accuracy:  64.7713% | Elapsed:     3s
Validation | Loss:     1.1364 | Accuracy:  58.9359% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.9270 | Accuracy:  67.5319% | Elapsed:     3s
Validation | Loss:     1.2676 | Accuracy:  59.6180% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.9429 | Accuracy:  66.6255% | Elapsed:     3s
Validation | Loss:     1.1131 | Accuracy:  63.1651% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.8669 | Accuracy:  69.8805% | Elapsed:     3s
Validation | Loss:     1.2451 | Accuracy:  56.0709% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.7692 | Accuracy:  74.3304% | Elapsed:     3s
Validation | Loss:     1.2147 | Accuracy:  63.4379% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.7424 | Accuracy:  74.3717% | Elapsed:     3s
Validation | Loss:     1.0162 | Accuracy:  65.4843% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.7060 | Accuracy:  75.8138% | Elapsed:     3s
Validation | Loss:     1.2977 | Accuracy:  62.0737% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.7517 | Accuracy:  73.4652% | Elapsed:     3s
Validation | Loss:     1.1013 | Accuracy:  62.3465% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.6321 | Accuracy:  77.3383% | Elapsed:     3s
Validation | Loss:     1.0460 | Accuracy:  68.0764% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.6003 | Accuracy:  79.6044% | Elapsed:     3s
Validation | Loss:     0.9567 | Accuracy:  68.3492% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.6036 | Accuracy:  79.3160% | Elapsed:     3s
Validation | Loss:     0.9907 | Accuracy:  68.4857% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.8379 | Accuracy:  69.7981% | Elapsed:     3s
Validation | Loss:     0.9419 | Accuracy:  67.6671% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.6766 | Accuracy:  76.1846% | Elapsed:     3s
Validation | Loss:     1.1650 | Accuracy:  65.0750% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5736 | Accuracy:  80.1401% | Elapsed:     3s
Validation | Loss:     1.0642 | Accuracy:  68.2128% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.6092 | Accuracy:  78.3684% | Elapsed:     4s
Validation | Loss:     1.3619 | Accuracy:  53.4789% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5606 | Accuracy:  81.2938% | Elapsed:     4s
Validation | Loss:     1.1337 | Accuracy:  66.9850% | Elapsed:     1s
-------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.5361 | Accuracy:  82.6123% | Elapsed:     3s
```

```
Validation | Loss:     1.1065 | Accuracy:  70.2592% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.5390 | Accuracy:  81.8706% | Elapsed:     3s
Validation | Loss:     1.0973 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.5570 | Accuracy:  81.1702% | Elapsed:     3s
Validation | Loss:     1.1880 | Accuracy:  65.8936% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.6391 | Accuracy:  78.6568% | Elapsed:     4s
Validation | Loss:     1.3244 | Accuracy:  66.3029% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.5096 | Accuracy:  82.4475% | Elapsed:     3s
Validation | Loss:     0.8855 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.4680 | Accuracy:  84.0544% | Elapsed:     3s
Validation | Loss:     1.3373 | Accuracy:  60.7094% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.4469 | Accuracy:  84.8372% | Elapsed:     3s
Validation | Loss:     1.1152 | Accuracy:  66.8486% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.4651 | Accuracy:  84.8785% | Elapsed:     3s
Validation | Loss:     0.9766 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.4213 | Accuracy:  85.6613% | Elapsed:     3s
Validation | Loss:     1.2296 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.4033 | Accuracy:  85.5789% | Elapsed:     3s
Validation | Loss:     1.1454 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3654 | Accuracy:  87.3918% | Elapsed:     3s
Validation | Loss:     0.8978 | Accuracy:  73.3970% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.4274 | Accuracy:  85.9909% | Elapsed:     3s
Validation | Loss:     1.1295 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.3616 | Accuracy:  87.9275% | Elapsed:     3s
Validation | Loss:     0.9423 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3263 | Accuracy:  89.0812% | Elapsed:     3s
Validation | Loss:     1.2695 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.3121 | Accuracy:  89.4520% | Elapsed:     3s
Validation | Loss:     1.2201 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3619 | Accuracy:  87.3506% | Elapsed:     4s
Validation | Loss:     1.0168 | Accuracy:  72.8513% | Elapsed:     1s
Epoch 00043: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2437 | Accuracy:  92.9543% | Elapsed:     3s
Validation | Loss:     1.0348 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2086 | Accuracy:  93.8195% | Elapsed:     3s
Validation | Loss:     1.0983 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.1962 | Accuracy:  94.1904% | Elapsed:     3s
Validation | Loss:     1.0831 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.1843 | Accuracy:  94.6436% | Elapsed:     3s
Validation | Loss:     1.1000 | Accuracy:  70.1228% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.1788 | Accuracy:  94.7672% | Elapsed:     3s
Validation | Loss:     1.1102 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.1707 | Accuracy:  95.0556% | Elapsed:     3s
Validation | Loss:     1.1519 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.1642 | Accuracy:  95.3028% | Elapsed:     3s
Validation | Loss:     1.1191 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 51/75
Training   | Loss:     0.1563 | Accuracy:  95.3852% | Elapsed:     3s
Validation | Loss:     1.2201 | Accuracy:  69.8499% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.1595 | Accuracy:  95.0144% | Elapsed:     4s
Validation | Loss:     1.1635 | Accuracy:  70.9413% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.1515 | Accuracy:  95.7149% | Elapsed:     4s
Validation | Loss:     1.1831 | Accuracy:  70.2592% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.1410 | Accuracy:  95.9209% | Elapsed:     4s
Validation | Loss:     1.1757 | Accuracy:  70.3956% | Elapsed:     1s
Epoch 00054: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1288 | Accuracy:  96.4977% | Elapsed:     4s
Validation | Loss:     1.1823 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1270 | Accuracy:  96.6625% | Elapsed:     3s
Validation | Loss:     1.1912 | Accuracy:  70.3956% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1260 | Accuracy:  96.6625% | Elapsed:     3s
Validation | Loss:     1.1965 | Accuracy:  70.3956% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1245 | Accuracy:  96.7862% | Elapsed:     3s
Validation | Loss:     1.1981 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1236 | Accuracy:  96.7037% | Elapsed:     3s
Validation | Loss:     1.1947 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1230 | Accuracy:  96.7037% | Elapsed:     3s
Validation | Loss:     1.1907 | Accuracy:  70.2592% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1215 | Accuracy:  96.7862% | Elapsed:     3s
Validation | Loss:     1.1904 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1209 | Accuracy:  96.7450% | Elapsed:     4s
Validation | Loss:     1.1884 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1200 | Accuracy:  96.7450% | Elapsed:     4s
Validation | Loss:     1.1897 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1191 | Accuracy:  96.8686% | Elapsed:     4s
Validation | Loss:     1.1900 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1182 | Accuracy:  96.8274% | Elapsed:     4s
Validation | Loss:     1.2007 | Accuracy:  70.5321% | Elapsed:     1s
Epoch 00065: reducing learning rate of group 0 to 1.0000e-06.
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1164 | Accuracy:  96.9098% | Elapsed:     4s
Validation | Loss:     1.1987 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1163 | Accuracy:  96.9098% | Elapsed:     4s
Validation | Loss:     1.1979 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1162 | Accuracy:  96.9510% | Elapsed:     4s
Validation | Loss:     1.1969 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1161 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     1.1952 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1160 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     1.1945 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1159 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     1.1941 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1158 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     1.1945 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
```

```
Training   | Loss:     0.1156 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     1.1941 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1155 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     1.1941 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1154 | Accuracy:  96.9098% | Elapsed:     3s
Validation | Loss:     1.1939 | Accuracy:  70.6685% | Elapsed:     1s
===========================================================================
Training complete in 5m 10s
Best model accuracy:  73.40%
===========================================================================
|
|
|
|
|

===========================================================================
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:     2.0474 | Accuracy:  23.1562% | Elapsed:     3s
Validation | Loss:     1.8641 | Accuracy:  31.5143% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6736 | Accuracy:  37.8657% | Elapsed:     3s
Validation | Loss:     2.0311 | Accuracy:  22.3738% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.6548 | Accuracy:  37.0828% | Elapsed:     3s
Validation | Loss:     1.5266 | Accuracy:  44.8840% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.4144 | Accuracy:  46.1887% | Elapsed:     3s
Validation | Loss:     1.8409 | Accuracy:  35.1978% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.3640 | Accuracy:  48.4961% | Elapsed:     3s
Validation | Loss:     1.4895 | Accuracy:  48.2947% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.3508 | Accuracy:  47.7132% | Elapsed:     3s
Validation | Loss:     1.6081 | Accuracy:  38.8813% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.2528 | Accuracy:  53.0696% | Elapsed:     3s
Validation | Loss:     1.3421 | Accuracy:  54.4338% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.1842 | Accuracy:  55.5418% | Elapsed:     3s
Validation | Loss:     1.3966 | Accuracy:  51.1596% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.1733 | Accuracy:  55.2122% | Elapsed:     3s
Validation | Loss:     1.7144 | Accuracy:  44.4748% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.1683 | Accuracy:  55.9539% | Elapsed:     3s
Validation | Loss:     1.5013 | Accuracy:  49.2497% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.2313 | Accuracy:  53.1932% | Elapsed:     3s
Validation | Loss:     1.4641 | Accuracy:  45.8390% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.1871 | Accuracy:  55.0062% | Elapsed:     3s
Validation | Loss:     1.3842 | Accuracy:  48.5675% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.0941 | Accuracy:  59.5797% | Elapsed:     4s
Validation | Loss:     1.4331 | Accuracy:  49.1132% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.0133 | Accuracy:  61.1454% | Elapsed:     4s
Validation | Loss:     1.1963 | Accuracy:  61.1187% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.9684 | Accuracy:  64.4829% | Elapsed:     4s
Validation | Loss:     1.1823 | Accuracy:  59.4816% | Elapsed:     1s
---------------------------------------------------------------------------
```

```
Epoch 16/75
Training   | Loss:     1.0230 | Accuracy:  63.8237% | Elapsed:     4s
Validation | Loss:     1.4712 | Accuracy:  45.9754% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.0896 | Accuracy:  60.2802% | Elapsed:     4s
Validation | Loss:     1.3738 | Accuracy:  54.0246% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.0450 | Accuracy:  62.0107% | Elapsed:     4s
Validation | Loss:     1.3452 | Accuracy:  50.0682% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.9396 | Accuracy:  67.5731% | Elapsed:     4s
Validation | Loss:     1.1054 | Accuracy:  61.5280% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.8151 | Accuracy:  72.4351% | Elapsed:     4s
Validation | Loss:     1.0940 | Accuracy:  60.4366% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.8195 | Accuracy:  71.8171% | Elapsed:     4s
Validation | Loss:     0.9917 | Accuracy:  67.1214% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.7768 | Accuracy:  72.8471% | Elapsed:     4s
Validation | Loss:     1.1427 | Accuracy:  60.3001% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.7563 | Accuracy:  73.4652% | Elapsed:     3s
Validation | Loss:     0.9241 | Accuracy:  71.4870% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.8160 | Accuracy:  73.1768% | Elapsed:     3s
Validation | Loss:     1.5925 | Accuracy:  54.7067% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.8817 | Accuracy:  71.0754% | Elapsed:     3s
Validation | Loss:     0.9931 | Accuracy:  69.1678% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.7520 | Accuracy:  75.5253% | Elapsed:     3s
Validation | Loss:     1.0198 | Accuracy:  65.2115% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.6780 | Accuracy:  77.0911% | Elapsed:     3s
Validation | Loss:     1.4912 | Accuracy:  58.2538% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.6473 | Accuracy:  78.6568% | Elapsed:     3s
Validation | Loss:     1.3363 | Accuracy:  57.2988% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.7297 | Accuracy:  76.2670% | Elapsed:     3s
Validation | Loss:     1.0279 | Accuracy:  67.2578% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.7373 | Accuracy:  75.3605% | Elapsed:     3s
Validation | Loss:     1.1976 | Accuracy:  59.4816% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.7778 | Accuracy:  74.7013% | Elapsed:     3s
Validation | Loss:     1.1011 | Accuracy:  66.5757% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.7238 | Accuracy:  76.2258% | Elapsed:     3s
Validation | Loss:     1.5853 | Accuracy:  51.5689% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.7440 | Accuracy:  75.6077% | Elapsed:     3s
Validation | Loss:     1.0778 | Accuracy:  65.8936% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.6881 | Accuracy:  77.3795% | Elapsed:     3s
Validation | Loss:     1.0719 | Accuracy:  63.3015% | Elapsed:     1s
Epoch 00034: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.5842 | Accuracy:  81.2526% | Elapsed:     3s
Validation | Loss:     0.9896 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.5163 | Accuracy:  84.0956% | Elapsed:     3s
Validation | Loss:     1.0036 | Accuracy:  69.4407% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.4815 | Accuracy:  85.1669% | Elapsed:     3s
Validation | Loss:     1.0354 | Accuracy:  68.6221% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.4601 | Accuracy:  85.7437% | Elapsed:     4s
```

```
Validation | Loss:     1.0267 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.4378 | Accuracy:  86.2794% | Elapsed:     4s
Validation | Loss:     1.0435 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.4182 | Accuracy:  87.1034% | Elapsed:     3s
Validation | Loss:     1.0335 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.4024 | Accuracy:  87.6803% | Elapsed:     3s
Validation | Loss:     1.1279 | Accuracy:  68.6221% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.4006 | Accuracy:  87.0210% | Elapsed:     3s
Validation | Loss:     1.0356 | Accuracy:  70.2592% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3848 | Accuracy:  87.8863% | Elapsed:     3s
Validation | Loss:     1.2130 | Accuracy:  66.7121% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.3755 | Accuracy:  88.5043% | Elapsed:     3s
Validation | Loss:     1.0489 | Accuracy:  71.6235% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.3581 | Accuracy:  89.0400% | Elapsed:     3s
Validation | Loss:     1.0810 | Accuracy:  70.8049% | Elapsed:     1s
Epoch 00045: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.3382 | Accuracy:  89.6992% | Elapsed:     3s
Validation | Loss:     1.0666 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.3330 | Accuracy:  89.8640% | Elapsed:     3s
Validation | Loss:     1.0779 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.3303 | Accuracy:  89.8228% | Elapsed:     3s
Validation | Loss:     1.0808 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.3282 | Accuracy:  89.9876% | Elapsed:     3s
Validation | Loss:     1.0874 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.3259 | Accuracy:  90.1525% | Elapsed:     3s
Validation | Loss:     1.0809 | Accuracy:  70.5321% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.3248 | Accuracy:  90.2349% | Elapsed:     3s
Validation | Loss:     1.0841 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.3225 | Accuracy:  90.2349% | Elapsed:     3s
Validation | Loss:     1.0832 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.3201 | Accuracy:  90.3585% | Elapsed:     3s
Validation | Loss:     1.0833 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.3183 | Accuracy:  90.3585% | Elapsed:     3s
Validation | Loss:     1.0923 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.3162 | Accuracy:  90.4821% | Elapsed:     3s
Validation | Loss:     1.1041 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.3140 | Accuracy:  90.4821% | Elapsed:     3s
Validation | Loss:     1.0898 | Accuracy:  71.0778% | Elapsed:     1s
Epoch 00056: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.3109 | Accuracy:  90.6469% | Elapsed:     3s
Validation | Loss:     1.0938 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.3101 | Accuracy:  90.6469% | Elapsed:     4s
Validation | Loss:     1.0974 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.3097 | Accuracy:  90.6881% | Elapsed:     3s
Validation | Loss:     1.1002 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.3094 | Accuracy:  90.6881% | Elapsed:     4s
Validation | Loss:     1.1022 | Accuracy:  71.0778% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.3091 | Accuracy:  90.7293% | Elapsed:     3s
Validation | Loss:     1.1033 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.3089 | Accuracy:  90.6881% | Elapsed:     3s
Validation | Loss:     1.1041 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.3086 | Accuracy:  90.7293% | Elapsed:     3s
Validation | Loss:     1.1054 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.3083 | Accuracy:  90.7705% | Elapsed:     4s
Validation | Loss:     1.1056 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.3081 | Accuracy:  90.7293% | Elapsed:     4s
Validation | Loss:     1.1064 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.3079 | Accuracy:  90.7293% | Elapsed:     4s
Validation | Loss:     1.1063 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.3076 | Accuracy:  90.7293% | Elapsed:     3s
Validation | Loss:     1.1073 | Accuracy:  71.2142% | Elapsed:     1s
Epoch 00067: reducing learning rate of group 0 to 1.0000e-07.
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.3072 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.1073 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.3072 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.1073 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.3071 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.1074 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.3071 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.1073 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.3071 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.1073 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.3071 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.1073 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.3070 | Accuracy:  90.7705% | Elapsed:     4s
Validation | Loss:     1.1075 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.3070 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.1075 | Accuracy:  71.2142% | Elapsed:     1s
================================================================================
Training complete in 5m 10s
Best model accuracy:  71.62%
================================================================================
|
|
|
|
|

================================================================================
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:     2.0036 | Accuracy:  22.2085% | Elapsed:     3s
Validation | Loss:     1.8350 | Accuracy:  34.2428% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.7472 | Accuracy:  34.2810% | Elapsed:     4s
Validation | Loss:     2.0495 | Accuracy:  26.8759% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
```

```
Training   | Loss:     1.5995 | Accuracy:  40.1731% | Elapsed:     4s
Validation | Loss:     1.7305 | Accuracy:  40.7913% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.5323 | Accuracy:  41.4504% | Elapsed:     3s
Validation | Loss:     1.7725 | Accuracy:  33.4243% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.4282 | Accuracy:  45.7355% | Elapsed:     3s
Validation | Loss:     1.5309 | Accuracy:  39.0177% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.4662 | Accuracy:  44.3346% | Elapsed:     3s
Validation | Loss:     1.6598 | Accuracy:  41.6098% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.3713 | Accuracy:  48.8669% | Elapsed:     3s
Validation | Loss:     1.5663 | Accuracy:  47.7490% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.3856 | Accuracy:  48.2901% | Elapsed:     3s
Validation | Loss:     1.4378 | Accuracy:  46.2483% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.2908 | Accuracy:  51.7511% | Elapsed:     3s
Validation | Loss:     1.5881 | Accuracy:  39.0177% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.3986 | Accuracy:  46.7656% | Elapsed:     3s
Validation | Loss:     1.6658 | Accuracy:  39.8363% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.3537 | Accuracy:  49.8146% | Elapsed:     3s
Validation | Loss:     1.9266 | Accuracy:  31.1050% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.3411 | Accuracy:  49.8146% | Elapsed:     4s
Validation | Loss:     1.5489 | Accuracy:  44.8840% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.3049 | Accuracy:  51.3803% | Elapsed:     4s
Validation | Loss:     1.7091 | Accuracy:  39.5634% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.2199 | Accuracy:  54.9650% | Elapsed:     3s
Validation | Loss:     1.3927 | Accuracy:  46.5211% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.3347 | Accuracy:  50.4326% | Elapsed:     4s
Validation | Loss:     1.5998 | Accuracy:  43.9291% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.3687 | Accuracy:  48.7021% | Elapsed:     4s
Validation | Loss:     1.4921 | Accuracy:  46.1119% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.2738 | Accuracy:  53.3169% | Elapsed:     4s
Validation | Loss:     1.4219 | Accuracy:  42.7012% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.3165 | Accuracy:  50.0618% | Elapsed:     4s
Validation | Loss:     1.6268 | Accuracy:  36.5621% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.2916 | Accuracy:  52.6164% | Elapsed:     3s
Validation | Loss:     1.6620 | Accuracy:  46.3847% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.3293 | Accuracy:  50.5974% | Elapsed:     3s
Validation | Loss:     1.6094 | Accuracy:  50.6139% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.3014 | Accuracy:  53.7289% | Elapsed:     3s
Validation | Loss:     1.6275 | Accuracy:  40.9277% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.2155 | Accuracy:  55.0886% | Elapsed:     3s
Validation | Loss:     1.4093 | Accuracy:  51.9782% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.1309 | Accuracy:  59.9094% | Elapsed:     3s
Validation | Loss:     1.3564 | Accuracy:  52.7967% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.2490 | Accuracy:  55.0474% | Elapsed:     3s
Validation | Loss:     1.3920 | Accuracy:  53.2060% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.2095 | Accuracy:  56.2011% | Elapsed:     3s
Validation | Loss:     1.3828 | Accuracy:  49.9318% | Elapsed:     1s
---------------------------------------------------------------------------
```

```
Epoch 26/75
Training   | Loss:     1.1736 | Accuracy:  58.2200% | Elapsed:     3s
Validation | Loss:     1.3506 | Accuracy:  56.6166% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.3884 | Accuracy:  49.4438% | Elapsed:     3s
Validation | Loss:     1.8937 | Accuracy:  29.7408% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     1.3783 | Accuracy:  49.9794% | Elapsed:     3s
Validation | Loss:     1.6067 | Accuracy:  40.3820% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.2962 | Accuracy:  51.5863% | Elapsed:     3s
Validation | Loss:     1.4865 | Accuracy:  48.0218% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.2060 | Accuracy:  56.3659% | Elapsed:     3s
Validation | Loss:     1.5645 | Accuracy:  47.3397% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.2756 | Accuracy:  53.8113% | Elapsed:     3s
Validation | Loss:     1.3813 | Accuracy:  52.2510% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     1.2237 | Accuracy:  55.2122% | Elapsed:     4s
Validation | Loss:     1.5627 | Accuracy:  43.7926% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     1.5103 | Accuracy:  43.8813% | Elapsed:     4s
Validation | Loss:     1.8907 | Accuracy:  27.8308% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     1.5595 | Accuracy:  39.8434% | Elapsed:     4s
Validation | Loss:     1.5417 | Accuracy:  45.2933% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.4215 | Accuracy:  45.9827% | Elapsed:     3s
Validation | Loss:     1.5311 | Accuracy:  47.3397% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     1.4407 | Accuracy:  44.9526% | Elapsed:     4s
Validation | Loss:     1.4543 | Accuracy:  48.1583% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     1.3139 | Accuracy:  51.1743% | Elapsed:     3s
Validation | Loss:     1.3809 | Accuracy:  52.6603% | Elapsed:     1s
Epoch 00037: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     1.1389 | Accuracy:  62.5052% | Elapsed:     3s
Validation | Loss:     1.3785 | Accuracy:  54.0246% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     1.0888 | Accuracy:  62.5464% | Elapsed:     3s
Validation | Loss:     1.3613 | Accuracy:  51.5689% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     1.0694 | Accuracy:  63.7824% | Elapsed:     3s
Validation | Loss:     1.4458 | Accuracy:  46.7940% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     1.0666 | Accuracy:  63.1644% | Elapsed:     3s
Validation | Loss:     1.3671 | Accuracy:  51.7053% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     1.0476 | Accuracy:  64.7301% | Elapsed:     3s
Validation | Loss:     1.3719 | Accuracy:  51.5689% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     1.0271 | Accuracy:  65.1834% | Elapsed:     3s
Validation | Loss:     1.3409 | Accuracy:  52.5239% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.9927 | Accuracy:  67.1199% | Elapsed:     4s
Validation | Loss:     1.3121 | Accuracy:  53.7517% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     1.0201 | Accuracy:  65.6366% | Elapsed:     3s
Validation | Loss:     1.2910 | Accuracy:  54.4338% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.9740 | Accuracy:  67.4495% | Elapsed:     3s
Validation | Loss:     1.6870 | Accuracy:  39.9727% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     1.0916 | Accuracy:  63.6588% | Elapsed:     3s
Validation | Loss:     1.3023 | Accuracy:  53.7517% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.9721 | Accuracy:  67.2435% | Elapsed:     3s
```

```
Validation | Loss:     1.3498 | Accuracy:  54.2974% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.9497 | Accuracy:  68.0264% | Elapsed:     3s
Validation | Loss:     1.2923 | Accuracy:  54.5703% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.9301 | Accuracy:  68.1912% | Elapsed:     3s
Validation | Loss:     1.2626 | Accuracy:  56.6166% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.9123 | Accuracy:  69.8805% | Elapsed:     3s
Validation | Loss:     1.2739 | Accuracy:  56.2074% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.9116 | Accuracy:  69.0152% | Elapsed:     4s
Validation | Loss:     1.2577 | Accuracy:  57.1623% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.9030 | Accuracy:  68.7268% | Elapsed:     4s
Validation | Loss:     1.3430 | Accuracy:  54.1610% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.8925 | Accuracy:  69.6745% | Elapsed:     3s
Validation | Loss:     1.2754 | Accuracy:  55.3888% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.8789 | Accuracy:  70.2101% | Elapsed:     3s
Validation | Loss:     1.2078 | Accuracy:  58.5266% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.8936 | Accuracy:  69.3861% | Elapsed:     3s
Validation | Loss:     1.2777 | Accuracy:  56.3438% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.8592 | Accuracy:  71.1578% | Elapsed:     3s
Validation | Loss:     1.2703 | Accuracy:  55.3888% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.8560 | Accuracy:  71.2402% | Elapsed:     3s
Validation | Loss:     1.1822 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.8435 | Accuracy:  71.3226% | Elapsed:     3s
Validation | Loss:     1.2455 | Accuracy:  56.0709% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.8506 | Accuracy:  71.3226% | Elapsed:     4s
Validation | Loss:     1.2340 | Accuracy:  57.0259% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.8401 | Accuracy:  71.9407% | Elapsed:     3s
Validation | Loss:     1.1888 | Accuracy:  60.3001% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.9382 | Accuracy:  67.9440% | Elapsed:     3s
Validation | Loss:     1.2877 | Accuracy:  55.9345% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.8492 | Accuracy:  71.1578% | Elapsed:     4s
Validation | Loss:     1.2090 | Accuracy:  60.4366% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.8060 | Accuracy:  73.2180% | Elapsed:     3s
Validation | Loss:     1.2113 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.7957 | Accuracy:  73.5064% | Elapsed:     3s
Validation | Loss:     1.2102 | Accuracy:  59.4816% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.7988 | Accuracy:  72.5999% | Elapsed:     3s
Validation | Loss:     1.1884 | Accuracy:  60.9823% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.7895 | Accuracy:  73.3416% | Elapsed:     3s
Validation | Loss:     1.3005 | Accuracy:  56.7531% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.8850 | Accuracy:  70.2925% | Elapsed:     3s
Validation | Loss:     1.2934 | Accuracy:  57.5716% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.7887 | Accuracy:  73.7124% | Elapsed:     4s
Validation | Loss:     1.2670 | Accuracy:  56.4802% | Elapsed:     1s
Epoch 00069: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.7517 | Accuracy:  74.9073% | Elapsed:     3s
Validation | Loss:     1.2494 | Accuracy:  57.5716% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 71/75
Training   | Loss:     0.7414 | Accuracy:  75.6902% | Elapsed:     3s
Validation | Loss:     1.2216 | Accuracy:  58.2538% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.7351 | Accuracy:  76.3494% | Elapsed:     3s
Validation | Loss:     1.2217 | Accuracy:  58.7995% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.7333 | Accuracy:  76.1434% | Elapsed:     3s
Validation | Loss:     1.1950 | Accuracy:  59.7544% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.7286 | Accuracy:  76.5966% | Elapsed:     4s
Validation | Loss:     1.2063 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.7295 | Accuracy:  76.5142% | Elapsed:     3s
Validation | Loss:     1.2066 | Accuracy:  59.6180% | Elapsed:     1s
===========================================================================
Training complete in 5m 5s
Best model accuracy:  60.98%
===========================================================================
|
|
|
|
|

===========================================================================
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:     1.9779 | Accuracy:  25.2987% | Elapsed:     3s
Validation | Loss:     1.8722 | Accuracy:  29.6044% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5871 | Accuracy:  46.2711% | Elapsed:     3s
Validation | Loss:     1.6665 | Accuracy:  37.3806% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3464 | Accuracy:  54.6354% | Elapsed:     3s
Validation | Loss:     1.4153 | Accuracy:  49.7954% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.1776 | Accuracy:  60.5686% | Elapsed:     3s
Validation | Loss:     1.3441 | Accuracy:  53.8881% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.0635 | Accuracy:  64.8125% | Elapsed:     3s
Validation | Loss:     1.2561 | Accuracy:  53.2060% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     0.9858 | Accuracy:  66.7903% | Elapsed:     3s
Validation | Loss:     1.4801 | Accuracy:  45.4297% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.9207 | Accuracy:  69.1389% | Elapsed:     3s
Validation | Loss:     1.1674 | Accuracy:  60.3001% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.8190 | Accuracy:  73.5064% | Elapsed:     3s
Validation | Loss:     1.1099 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.7814 | Accuracy:  75.4841% | Elapsed:     3s
Validation | Loss:     1.0768 | Accuracy:  63.9836% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.7218 | Accuracy:  77.6679% | Elapsed:     3s
Validation | Loss:     0.9341 | Accuracy:  69.5771% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.6927 | Accuracy:  78.2859% | Elapsed:     3s
Validation | Loss:     1.1802 | Accuracy:  60.5730% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.6546 | Accuracy:  79.6044% | Elapsed:     3s
Validation | Loss:     0.9888 | Accuracy:  64.6658% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.6186 | Accuracy:  81.2938% | Elapsed:     3s
Validation | Loss:     1.0460 | Accuracy:  63.3015% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.5886 | Accuracy:  83.1067% | Elapsed:     3s
Validation | Loss:     0.9925 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.5720 | Accuracy:  83.3951% | Elapsed:     4s
Validation | Loss:     0.9500 | Accuracy:  68.3492% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.5552 | Accuracy:  83.6012% | Elapsed:     4s
Validation | Loss:     0.8974 | Accuracy:  70.2592% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.5548 | Accuracy:  83.1067% | Elapsed:     4s
Validation | Loss:     0.9786 | Accuracy:  66.0300% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.5211 | Accuracy:  84.8785% | Elapsed:     4s
Validation | Loss:     0.8258 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.5006 | Accuracy:  84.4252% | Elapsed:     4s
Validation | Loss:     0.8938 | Accuracy:  70.6685% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.4633 | Accuracy:  86.4442% | Elapsed:     4s
Validation | Loss:     0.9235 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.4589 | Accuracy:  86.7326% | Elapsed:     4s
Validation | Loss:     0.9014 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.4606 | Accuracy:  86.8974% | Elapsed:     4s
Validation | Loss:     0.9470 | Accuracy:  69.3042% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.4269 | Accuracy:  87.1858% | Elapsed:     4s
Validation | Loss:     0.8393 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.4317 | Accuracy:  87.4330% | Elapsed:     4s
Validation | Loss:     0.8256 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.4745 | Accuracy:  85.4965% | Elapsed:     4s
Validation | Loss:     0.9170 | Accuracy:  70.2592% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.4126 | Accuracy:  88.4219% | Elapsed:     4s
Validation | Loss:     0.8913 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.3896 | Accuracy:  88.9164% | Elapsed:     4s
Validation | Loss:     0.8333 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.3917 | Accuracy:  88.3807% | Elapsed:     4s
Validation | Loss:     0.9299 | Accuracy:  64.9386% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.4598 | Accuracy:  85.9497% | Elapsed:     4s
Validation | Loss:     0.8944 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.4034 | Accuracy:  88.0923% | Elapsed:     4s
Validation | Loss:     0.9025 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.3763 | Accuracy:  88.9164% | Elapsed:     4s
Validation | Loss:     0.7610 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.3770 | Accuracy:  89.5756% | Elapsed:     3s
Validation | Loss:     0.8128 | Accuracy:  75.5798% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.3837 | Accuracy:  89.5344% | Elapsed:     4s
Validation | Loss:     0.8881 | Accuracy:  73.3970% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.3558 | Accuracy:  90.2761% | Elapsed:     3s
Validation | Loss:     0.7463 | Accuracy:  75.0341% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.3497 | Accuracy:  89.9464% | Elapsed:     3s
Validation | Loss:     0.6851 | Accuracy:  77.4898% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.3393 | Accuracy:  90.3173% | Elapsed:     3s
```

```
Validation | Loss:     0.8916 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3354 | Accuracy:  90.9765% | Elapsed:     3s
Validation | Loss:     0.7332 | Accuracy:  75.1705% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3298 | Accuracy:  90.7293% | Elapsed:     3s
Validation | Loss:     0.7075 | Accuracy:  75.8527% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3530 | Accuracy:  89.2872% | Elapsed:     3s
Validation | Loss:     0.8659 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.3442 | Accuracy:  89.9464% | Elapsed:     3s
Validation | Loss:     0.7670 | Accuracy:  75.8527% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3279 | Accuracy:  90.8117% | Elapsed:     4s
Validation | Loss:     0.7307 | Accuracy:  76.2619% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.3494 | Accuracy:  89.9876% | Elapsed:     4s
Validation | Loss:     0.7413 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3579 | Accuracy:  90.4821% | Elapsed:     3s
Validation | Loss:     0.8055 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.3741 | Accuracy:  90.0288% | Elapsed:     3s
Validation | Loss:     0.7194 | Accuracy:  75.3070% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.3549 | Accuracy:  90.2349% | Elapsed:     4s
Validation | Loss:     0.8255 | Accuracy:  71.6235% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.3505 | Accuracy:  91.0177% | Elapsed:     4s
Validation | Loss:     0.9359 | Accuracy:  68.8950% | Elapsed:     1s
Epoch 00046: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2782 | Accuracy:  93.6959% | Elapsed:     4s
Validation | Loss:     0.7148 | Accuracy:  76.3984% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2548 | Accuracy:  94.7260% | Elapsed:     4s
Validation | Loss:     0.7125 | Accuracy:  76.6712% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2511 | Accuracy:  94.7260% | Elapsed:     3s
Validation | Loss:     0.7313 | Accuracy:  75.8527% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2458 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     0.7401 | Accuracy:  76.1255% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2434 | Accuracy:  94.8496% | Elapsed:     3s
Validation | Loss:     0.7346 | Accuracy:  76.3984% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2391 | Accuracy:  95.0968% | Elapsed:     4s
Validation | Loss:     0.7289 | Accuracy:  76.1255% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2353 | Accuracy:  94.9320% | Elapsed:     3s
Validation | Loss:     0.7634 | Accuracy:  75.4434% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2298 | Accuracy:  94.8496% | Elapsed:     3s
Validation | Loss:     0.7460 | Accuracy:  75.8527% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.2166 | Accuracy:  94.7260% | Elapsed:     4s
Validation | Loss:     0.7887 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.2072 | Accuracy:  95.0556% | Elapsed:     4s
Validation | Loss:     0.7734 | Accuracy:  75.4434% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1926 | Accuracy:  95.5089% | Elapsed:     4s
Validation | Loss:     0.7699 | Accuracy:  74.4884% | Elapsed:     1s
Epoch 00057: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1771 | Accuracy:  95.7561% | Elapsed:     4s
Validation | Loss:     0.7736 | Accuracy:  74.3520% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1736 | Accuracy:  95.9621% | Elapsed:     4s
Validation | Loss:     0.7750 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1718 | Accuracy:  96.1269% | Elapsed:     3s
Validation | Loss:     0.7749 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1708 | Accuracy:  96.3329% | Elapsed:     3s
Validation | Loss:     0.7741 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1700 | Accuracy:  96.2093% | Elapsed:     3s
Validation | Loss:     0.7778 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1690 | Accuracy:  96.2505% | Elapsed:     3s
Validation | Loss:     0.7773 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1681 | Accuracy:  96.4153% | Elapsed:     4s
Validation | Loss:     0.7753 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1670 | Accuracy:  96.2917% | Elapsed:     4s
Validation | Loss:     0.7836 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1661 | Accuracy:  96.4977% | Elapsed:     4s
Validation | Loss:     0.7808 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1647 | Accuracy:  96.3329% | Elapsed:     4s
Validation | Loss:     0.7779 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1640 | Accuracy:  96.5801% | Elapsed:     4s
Validation | Loss:     0.7826 | Accuracy:  74.0791% | Elapsed:     1s
Epoch 00068: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1616 | Accuracy:  96.5801% | Elapsed:     4s
Validation | Loss:     0.7827 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1615 | Accuracy:  96.6213% | Elapsed:     4s
Validation | Loss:     0.7822 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1613 | Accuracy:  96.6213% | Elapsed:     4s
Validation | Loss:     0.7816 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1612 | Accuracy:  96.6213% | Elapsed:     4s
Validation | Loss:     0.7822 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1611 | Accuracy:  96.6213% | Elapsed:     4s
Validation | Loss:     0.7823 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1610 | Accuracy:  96.6213% | Elapsed:     4s
Validation | Loss:     0.7817 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1609 | Accuracy:  96.6625% | Elapsed:     4s
Validation | Loss:     0.7820 | Accuracy:  74.2156% | Elapsed:     1s
================================================================================
Training complete in 5m 6s
Best model accuracy:  77.49%
================================================================================
|
|
|
|
|

================================================================================
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:     1.9795 | Accuracy:  27.1529% | Elapsed:     4s
Validation | Loss:     1.9035 | Accuracy:  32.0600% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6151 | Accuracy:  43.7577% | Elapsed:     3s
Validation | Loss:     1.6754 | Accuracy:  43.1105% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3905 | Accuracy:  50.5150% | Elapsed:     4s
Validation | Loss:     1.4838 | Accuracy:  47.8854% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2641 | Accuracy:  56.8603% | Elapsed:     4s
Validation | Loss:     1.4466 | Accuracy:  49.5225% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1443 | Accuracy:  62.4227% | Elapsed:     4s
Validation | Loss:     1.3890 | Accuracy:  49.9318% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.0779 | Accuracy:  64.2357% | Elapsed:     4s
Validation | Loss:     1.3067 | Accuracy:  55.6617% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.9898 | Accuracy:  68.7680% | Elapsed:     3s
Validation | Loss:     1.3020 | Accuracy:  54.9795% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9210 | Accuracy:  71.0342% | Elapsed:     4s
Validation | Loss:     1.1643 | Accuracy:  57.2988% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.8990 | Accuracy:  71.7759% | Elapsed:     4s
Validation | Loss:     1.1141 | Accuracy:  61.1187% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8577 | Accuracy:  73.5888% | Elapsed:     3s
Validation | Loss:     1.0941 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.8215 | Accuracy:  74.1244% | Elapsed:     3s
Validation | Loss:     1.1246 | Accuracy:  60.7094% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.7700 | Accuracy:  76.7614% | Elapsed:     4s
Validation | Loss:     1.0365 | Accuracy:  60.5730% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.7211 | Accuracy:  78.1211% | Elapsed:     4s
Validation | Loss:     0.9996 | Accuracy:  65.4843% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.7040 | Accuracy:  78.6980% | Elapsed:     4s
Validation | Loss:     1.0639 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.6717 | Accuracy:  79.6044% | Elapsed:     4s
Validation | Loss:     0.9037 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.6641 | Accuracy:  79.2336% | Elapsed:     4s
Validation | Loss:     0.9736 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.6438 | Accuracy:  81.2938% | Elapsed:     3s
Validation | Loss:     1.0452 | Accuracy:  64.2565% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.6348 | Accuracy:  81.0878% | Elapsed:     4s
Validation | Loss:     0.9543 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.6493 | Accuracy:  80.3049% | Elapsed:     3s
Validation | Loss:     1.0000 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.6056 | Accuracy:  82.3651% | Elapsed:     3s
Validation | Loss:     0.9805 | Accuracy:  66.4393% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.5944 | Accuracy:  82.4475% | Elapsed:     4s
Validation | Loss:     0.9145 | Accuracy:  67.6671% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.5669 | Accuracy:  83.5187% | Elapsed:     4s
Validation | Loss:     1.1910 | Accuracy:  62.0737% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.5846 | Accuracy:  83.3951% | Elapsed:     4s
Validation | Loss:     0.8782 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 24/75
Training   | Loss:     0.5365 | Accuracy:  84.5900% | Elapsed:     4s
Validation | Loss:     0.9742 | Accuracy:  69.1678% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5345 | Accuracy:  85.0845% | Elapsed:     4s
Validation | Loss:     0.8024 | Accuracy:  74.2156% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.5249 | Accuracy:  84.6724% | Elapsed:     3s
Validation | Loss:     0.9075 | Accuracy:  68.2128% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5283 | Accuracy:  83.7660% | Elapsed:     3s
Validation | Loss:     1.0065 | Accuracy:  66.9850% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.5052 | Accuracy:  85.8261% | Elapsed:     3s
Validation | Loss:     0.8816 | Accuracy:  70.2592% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.4974 | Accuracy:  85.8261% | Elapsed:     3s
Validation | Loss:     0.8487 | Accuracy:  71.0778% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.4638 | Accuracy:  86.6090% | Elapsed:     3s
Validation | Loss:     0.8272 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.4772 | Accuracy:  85.9909% | Elapsed:     3s
Validation | Loss:     0.8567 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.4898 | Accuracy:  85.6613% | Elapsed:     3s
Validation | Loss:     0.8323 | Accuracy:  71.8963% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.5025 | Accuracy:  84.7136% | Elapsed:     3s
Validation | Loss:     0.9845 | Accuracy:  67.6671% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.4895 | Accuracy:  85.8261% | Elapsed:     3s
Validation | Loss:     1.0885 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.4627 | Accuracy:  87.4330% | Elapsed:     4s
Validation | Loss:     0.8574 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.4754 | Accuracy:  86.0733% | Elapsed:     4s
Validation | Loss:     0.9249 | Accuracy:  67.2578% | Elapsed:     1s
Epoch 00036: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3938 | Accuracy:  88.9988% | Elapsed:     4s
Validation | Loss:     0.8571 | Accuracy:  70.2592% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3567 | Accuracy:  90.8941% | Elapsed:     4s
Validation | Loss:     0.7897 | Accuracy:  72.8513% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3471 | Accuracy:  91.2649% | Elapsed:     4s
Validation | Loss:     0.8334 | Accuracy:  71.2142% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.3419 | Accuracy:  91.4297% | Elapsed:     4s
Validation | Loss:     0.8287 | Accuracy:  72.8513% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3338 | Accuracy:  91.4710% | Elapsed:     4s
Validation | Loss:     0.7948 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.3257 | Accuracy:  91.9654% | Elapsed:     4s
Validation | Loss:     0.8059 | Accuracy:  72.9877% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3215 | Accuracy:  92.2950% | Elapsed:     4s
Validation | Loss:     0.7355 | Accuracy:  75.4434% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2971 | Accuracy:  92.6658% | Elapsed:     4s
Validation | Loss:     0.7314 | Accuracy:  76.3984% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2925 | Accuracy:  92.7070% | Elapsed:     4s
Validation | Loss:     0.7687 | Accuracy:  75.1705% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2856 | Accuracy:  92.9131% | Elapsed:     4s
```

```
Validation | Loss:     0.7383 | Accuracy:  75.7162% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2833 | Accuracy:  93.2015% | Elapsed:     4s
Validation | Loss:     0.8100 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2791 | Accuracy:  93.5311% | Elapsed:     4s
Validation | Loss:     0.7218 | Accuracy:  75.4434% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2694 | Accuracy:  93.6547% | Elapsed:     4s
Validation | Loss:     0.7260 | Accuracy:  75.7162% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2639 | Accuracy:  93.8607% | Elapsed:     4s
Validation | Loss:     0.7197 | Accuracy:  77.2169% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2579 | Accuracy:  93.9843% | Elapsed:     4s
Validation | Loss:     0.7408 | Accuracy:  75.9891% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2534 | Accuracy:  94.4788% | Elapsed:     3s
Validation | Loss:     0.7308 | Accuracy:  76.3984% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2504 | Accuracy:  94.4376% | Elapsed:     3s
Validation | Loss:     0.7618 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2442 | Accuracy:  94.4788% | Elapsed:     3s
Validation | Loss:     0.7325 | Accuracy:  75.5798% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.2423 | Accuracy:  94.6848% | Elapsed:     3s
Validation | Loss:     0.7276 | Accuracy:  76.1255% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.2350 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.7898 | Accuracy:  73.3970% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.2336 | Accuracy:  94.5200% | Elapsed:     4s
Validation | Loss:     0.7387 | Accuracy:  75.4434% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.2349 | Accuracy:  94.4788% | Elapsed:     4s
Validation | Loss:     0.7759 | Accuracy:  74.3520% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.2293 | Accuracy:  94.6848% | Elapsed:     4s
Validation | Loss:     0.7631 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.2257 | Accuracy:  95.0968% | Elapsed:     4s
Validation | Loss:     0.7648 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.2259 | Accuracy:  95.0968% | Elapsed:     3s
Validation | Loss:     0.7051 | Accuracy:  76.3984% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2208 | Accuracy:  95.1792% | Elapsed:     4s
Validation | Loss:     0.7163 | Accuracy:  77.0805% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2176 | Accuracy:  95.0968% | Elapsed:     4s
Validation | Loss:     0.8130 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.2123 | Accuracy:  95.3440% | Elapsed:     3s
Validation | Loss:     0.7886 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2126 | Accuracy:  95.5089% | Elapsed:     3s
Validation | Loss:     0.7045 | Accuracy:  77.4898% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2092 | Accuracy:  95.2204% | Elapsed:     3s
Validation | Loss:     0.7359 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.2018 | Accuracy:  95.8797% | Elapsed:     3s
Validation | Loss:     0.7188 | Accuracy:  75.8527% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.2002 | Accuracy:  95.9209% | Elapsed:     3s
Validation | Loss:     0.6660 | Accuracy:  78.1719% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
```

```
Training   | Loss:     0.2042 | Accuracy:  95.5501% | Elapsed:     4s
Validation | Loss:     0.6989 | Accuracy:  76.3984% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1974 | Accuracy:  95.9209% | Elapsed:     4s
Validation | Loss:     0.6998 | Accuracy:  76.2619% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1950 | Accuracy:  95.4265% | Elapsed:     4s
Validation | Loss:     0.6986 | Accuracy:  76.8076% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1923 | Accuracy:  96.0445% | Elapsed:     4s
Validation | Loss:     0.6866 | Accuracy:  77.2169% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1926 | Accuracy:  95.8797% | Elapsed:     3s
Validation | Loss:     0.7331 | Accuracy:  75.9891% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1887 | Accuracy:  96.1681% | Elapsed:     3s
Validation | Loss:     0.7027 | Accuracy:  75.8527% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1950 | Accuracy:  96.0033% | Elapsed:     3s
Validation | Loss:     0.7483 | Accuracy:  74.3520% | Elapsed:     1s
===========================================================================
Training complete in 5m 13s
Best model accuracy:  78.17%
===========================================================================
|
|
|
|
|

===========================================================================
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:     1.9301 | Accuracy:  28.8422% | Elapsed:     3s
Validation | Loss:     1.8992 | Accuracy:  27.1487% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6796 | Accuracy:  39.1842% | Elapsed:     3s
Validation | Loss:     1.7498 | Accuracy:  34.3793% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.5667 | Accuracy:  44.3758% | Elapsed:     3s
Validation | Loss:     1.6408 | Accuracy:  38.8813% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.4715 | Accuracy:  48.6197% | Elapsed:     4s
Validation | Loss:     1.6420 | Accuracy:  45.5662% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.4103 | Accuracy:  52.1632% | Elapsed:     4s
Validation | Loss:     1.6386 | Accuracy:  46.9304% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.3870 | Accuracy:  52.7400% | Elapsed:     4s
Validation | Loss:     1.5509 | Accuracy:  45.8390% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.3342 | Accuracy:  55.0474% | Elapsed:     4s
Validation | Loss:     1.5906 | Accuracy:  48.4311% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.2947 | Accuracy:  57.5196% | Elapsed:     4s
Validation | Loss:     1.4698 | Accuracy:  51.5689% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.2452 | Accuracy:  60.0742% | Elapsed:     4s
Validation | Loss:     1.3868 | Accuracy:  54.1610% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.2279 | Accuracy:  60.0330% | Elapsed:     3s
Validation | Loss:     1.3362 | Accuracy:  57.0259% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.1836 | Accuracy:  62.9996% | Elapsed:     4s
Validation | Loss:     1.2844 | Accuracy:  61.2551% | Elapsed:     1s
---------------------------------------------------------------------------
```

```
Epoch 12/75
Training   | Loss:     1.1709 | Accuracy:  62.0519% | Elapsed:     4s
Validation | Loss:     1.3921 | Accuracy:  53.6153% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.1668 | Accuracy:  64.6889% | Elapsed:     4s
Validation | Loss:     1.3291 | Accuracy:  56.8895% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.1582 | Accuracy:  64.0297% | Elapsed:     3s
Validation | Loss:     1.2424 | Accuracy:  59.4816% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.1436 | Accuracy:  64.6477% | Elapsed:     3s
Validation | Loss:     1.3621 | Accuracy:  54.2974% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.1202 | Accuracy:  65.4718% | Elapsed:     4s
Validation | Loss:     1.2814 | Accuracy:  56.8895% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.0636 | Accuracy:  68.5208% | Elapsed:     4s
Validation | Loss:     1.3620 | Accuracy:  56.6166% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.0745 | Accuracy:  68.0676% | Elapsed:     4s
Validation | Loss:     1.2634 | Accuracy:  58.6630% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.0619 | Accuracy:  68.3148% | Elapsed:     4s
Validation | Loss:     1.2664 | Accuracy:  62.6194% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.0393 | Accuracy:  69.2625% | Elapsed:     4s
Validation | Loss:     1.2769 | Accuracy:  58.1173% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.0086 | Accuracy:  70.5810% | Elapsed:     3s
Validation | Loss:     1.1376 | Accuracy:  66.7121% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.9998 | Accuracy:  70.4986% | Elapsed:     4s
Validation | Loss:     1.1963 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.0265 | Accuracy:  70.5810% | Elapsed:     4s
Validation | Loss:     1.1355 | Accuracy:  63.9836% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.9868 | Accuracy:  71.8583% | Elapsed:     4s
Validation | Loss:     1.1897 | Accuracy:  63.8472% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.9927 | Accuracy:  70.7870% | Elapsed:     4s
Validation | Loss:     1.3319 | Accuracy:  55.1160% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.9518 | Accuracy:  72.7235% | Elapsed:     4s
Validation | Loss:     1.1398 | Accuracy:  64.3929% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.9988 | Accuracy:  70.8282% | Elapsed:     3s
Validation | Loss:     1.1051 | Accuracy:  65.7572% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.9773 | Accuracy:  72.0643% | Elapsed:     3s
Validation | Loss:     1.0881 | Accuracy:  68.4857% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.9654 | Accuracy:  72.8883% | Elapsed:     3s
Validation | Loss:     1.1874 | Accuracy:  65.3479% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.9719 | Accuracy:  73.3828% | Elapsed:     4s
Validation | Loss:     1.2577 | Accuracy:  61.8008% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.9665 | Accuracy:  72.8471% | Elapsed:     4s
Validation | Loss:     1.1172 | Accuracy:  66.1664% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.9880 | Accuracy:  71.5286% | Elapsed:     3s
Validation | Loss:     1.1833 | Accuracy:  60.3001% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.9430 | Accuracy:  73.7124% | Elapsed:     3s
Validation | Loss:     1.1169 | Accuracy:  66.3029% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.9271 | Accuracy:  73.1768% | Elapsed:     4s
Validation | Loss:     1.2296 | Accuracy:  60.9823% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.9313 | Accuracy:  73.2180% | Elapsed:     4s
Validation | Loss:     1.1168 | Accuracy:  66.7121% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.9151 | Accuracy:  74.4541% | Elapsed:     4s
Validation | Loss:     1.1446 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.9194 | Accuracy:  74.6189% | Elapsed:     4s
Validation | Loss:     1.2285 | Accuracy:  59.0723% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.9069 | Accuracy:  74.5365% | Elapsed:     4s
Validation | Loss:     1.0660 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.8926 | Accuracy:  75.4841% | Elapsed:     4s
Validation | Loss:     1.1759 | Accuracy:  62.6194% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.8815 | Accuracy:  75.8962% | Elapsed:     3s
Validation | Loss:     1.0146 | Accuracy:  71.6235% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.8931 | Accuracy:  74.9897% | Elapsed:     4s
Validation | Loss:     1.1024 | Accuracy:  67.5307% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.8849 | Accuracy:  75.6489% | Elapsed:     4s
Validation | Loss:     1.0756 | Accuracy:  67.8035% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.8965 | Accuracy:  76.4730% | Elapsed:     4s
Validation | Loss:     1.0052 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.8780 | Accuracy:  76.2670% | Elapsed:     4s
Validation | Loss:     1.1312 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.8775 | Accuracy:  76.0198% | Elapsed:     4s
Validation | Loss:     1.0482 | Accuracy:  64.6658% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.8983 | Accuracy:  75.0309% | Elapsed:     4s
Validation | Loss:     1.0876 | Accuracy:  68.2128% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.9122 | Accuracy:  75.6077% | Elapsed:     4s
Validation | Loss:     1.1812 | Accuracy:  62.8922% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.9044 | Accuracy:  75.1545% | Elapsed:     4s
Validation | Loss:     1.2120 | Accuracy:  59.8909% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.8975 | Accuracy:  74.9897% | Elapsed:     4s
Validation | Loss:     1.0867 | Accuracy:  68.3492% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.8761 | Accuracy:  75.6077% | Elapsed:     4s
Validation | Loss:     1.0259 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.8755 | Accuracy:  76.2258% | Elapsed:     3s
Validation | Loss:     1.1178 | Accuracy:  65.4843% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.8923 | Accuracy:  76.6378% | Elapsed:     3s
Validation | Loss:     1.1875 | Accuracy:  61.2551% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.8859 | Accuracy:  76.1846% | Elapsed:     4s
Validation | Loss:     1.1746 | Accuracy:  63.9836% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.8703 | Accuracy:  78.1623% | Elapsed:     3s
Validation | Loss:     1.1011 | Accuracy:  69.1678% | Elapsed:     1s
Epoch 00054: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.8010 | Accuracy:  81.6646% | Elapsed:     3s
Validation | Loss:     1.0676 | Accuracy:  67.6671% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.7730 | Accuracy:  81.5822% | Elapsed:     4s
Validation | Loss:     1.0718 | Accuracy:  67.5307% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
```

```
Training   | Loss:     0.7692 | Accuracy:  82.1590% | Elapsed:     3s
Validation | Loss:     1.0281 | Accuracy:  69.4407% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.7630 | Accuracy:  82.6535% | Elapsed:     3s
Validation | Loss:     1.0540 | Accuracy:  66.9850% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.7468 | Accuracy:  82.3239% | Elapsed:     3s
Validation | Loss:     1.0411 | Accuracy:  68.3492% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.7403 | Accuracy:  82.5711% | Elapsed:     4s
Validation | Loss:     1.0382 | Accuracy:  68.7585% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.7256 | Accuracy:  82.4063% | Elapsed:     4s
Validation | Loss:     1.0042 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.7132 | Accuracy:  82.6123% | Elapsed:     4s
Validation | Loss:     0.9692 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.7121 | Accuracy:  82.4887% | Elapsed:     4s
Validation | Loss:     0.9675 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.7042 | Accuracy:  83.2303% | Elapsed:     4s
Validation | Loss:     1.0178 | Accuracy:  69.5771% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.6963 | Accuracy:  84.1368% | Elapsed:     4s
Validation | Loss:     0.9641 | Accuracy:  69.8499% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.6941 | Accuracy:  83.2715% | Elapsed:     4s
Validation | Loss:     0.9810 | Accuracy:  70.1228% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.6891 | Accuracy:  82.4887% | Elapsed:     3s
Validation | Loss:     0.9885 | Accuracy:  70.9413% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.6837 | Accuracy:  83.8484% | Elapsed:     4s
Validation | Loss:     0.9799 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.6795 | Accuracy:  83.6836% | Elapsed:     4s
Validation | Loss:     0.9322 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.6671 | Accuracy:  84.0956% | Elapsed:     3s
Validation | Loss:     0.9398 | Accuracy:  71.2142% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.6614 | Accuracy:  83.6424% | Elapsed:     4s
Validation | Loss:     0.9867 | Accuracy:  68.0764% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.6594 | Accuracy:  83.2303% | Elapsed:     4s
Validation | Loss:     0.9668 | Accuracy:  69.1678% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.6530 | Accuracy:  84.3016% | Elapsed:     4s
Validation | Loss:     0.9230 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.6388 | Accuracy:  84.6724% | Elapsed:     4s
Validation | Loss:     0.9837 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.6441 | Accuracy:  84.6724% | Elapsed:     4s
Validation | Loss:     0.9602 | Accuracy:  71.4870% | Elapsed:     1s
===========================================================================
Training complete in 5m 15s
Best model accuracy:  72.17%
===========================================================================
|
|
|
|
|

===========================================================================
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:     1.9439 | Accuracy:  25.5871% | Elapsed:     4s
Validation | Loss:     2.0731 | Accuracy:  24.4202% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5723 | Accuracy:  39.8846% | Elapsed:     4s
Validation | Loss:     1.7469 | Accuracy:  36.5621% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3872 | Accuracy:  46.6007% | Elapsed:     4s
Validation | Loss:     1.5228 | Accuracy:  48.8404% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2279 | Accuracy:  53.3581% | Elapsed:     4s
Validation | Loss:     1.4818 | Accuracy:  44.0655% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1774 | Accuracy:  55.6242% | Elapsed:     4s
Validation | Loss:     1.6587 | Accuracy:  43.5198% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.1427 | Accuracy:  57.7256% | Elapsed:     4s
Validation | Loss:     1.2541 | Accuracy:  53.6153% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.0248 | Accuracy:  61.5987% | Elapsed:     4s
Validation | Loss:     1.1335 | Accuracy:  60.3001% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.0498 | Accuracy:  61.9695% | Elapsed:     3s
Validation | Loss:     1.0430 | Accuracy:  64.6658% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.9912 | Accuracy:  64.5653% | Elapsed:     4s
Validation | Loss:     1.2438 | Accuracy:  56.0709% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.0701 | Accuracy:  62.6700% | Elapsed:     3s
Validation | Loss:     1.1963 | Accuracy:  60.8458% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.9290 | Accuracy:  65.9662% | Elapsed:     3s
Validation | Loss:     1.2162 | Accuracy:  58.2538% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.7786 | Accuracy:  72.5587% | Elapsed:     4s
Validation | Loss:     1.0562 | Accuracy:  64.9386% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.8180 | Accuracy:  71.6522% | Elapsed:     3s
Validation | Loss:     0.9593 | Accuracy:  65.8936% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.7292 | Accuracy:  74.9897% | Elapsed:     3s
Validation | Loss:     0.9998 | Accuracy:  69.0314% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.8596 | Accuracy:  69.5097% | Elapsed:     3s
Validation | Loss:     1.2590 | Accuracy:  54.1610% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.8156 | Accuracy:  71.1166% | Elapsed:     3s
Validation | Loss:     0.9968 | Accuracy:  69.1678% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.7533 | Accuracy:  73.6712% | Elapsed:     4s
Validation | Loss:     1.1124 | Accuracy:  62.6194% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.7999 | Accuracy:  70.0865% | Elapsed:     3s
Validation | Loss:     1.0529 | Accuracy:  64.1201% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.6964 | Accuracy:  75.6489% | Elapsed:     3s
Validation | Loss:     1.0772 | Accuracy:  71.4870% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.6601 | Accuracy:  76.7614% | Elapsed:     3s
Validation | Loss:     1.0798 | Accuracy:  69.7135% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.7687 | Accuracy:  74.3304% | Elapsed:     3s
Validation | Loss:     1.0250 | Accuracy:  70.3956% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.5455 | Accuracy:  81.4998% | Elapsed:     3s
Validation | Loss:     1.0456 | Accuracy:  68.3492% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6091 | Accuracy:  79.1924% | Elapsed:     3s
Validation | Loss:     1.2407 | Accuracy:  57.8445% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.5706 | Accuracy:  81.0466% | Elapsed:     3s
Validation | Loss:     1.0456 | Accuracy:  69.0314% | Elapsed:     1s
Epoch 00024: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.3911 | Accuracy:  87.6803% | Elapsed:     3s
Validation | Loss:     0.9409 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.3534 | Accuracy:  88.6691% | Elapsed:     3s
Validation | Loss:     0.9987 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.3336 | Accuracy:  89.4108% | Elapsed:     3s
Validation | Loss:     0.9858 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.3162 | Accuracy:  90.1525% | Elapsed:     3s
Validation | Loss:     1.0561 | Accuracy:  70.1228% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.2999 | Accuracy:  90.6881% | Elapsed:     3s
Validation | Loss:     1.0374 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.2930 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.0362 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.2745 | Accuracy:  91.5534% | Elapsed:     3s
Validation | Loss:     1.0256 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.2637 | Accuracy:  91.6358% | Elapsed:     3s
Validation | Loss:     1.1455 | Accuracy:  69.9864% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.2588 | Accuracy:  92.0066% | Elapsed:     3s
Validation | Loss:     1.1211 | Accuracy:  70.3956% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.2486 | Accuracy:  92.2950% | Elapsed:     3s
Validation | Loss:     1.1964 | Accuracy:  69.4407% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.2462 | Accuracy:  92.2126% | Elapsed:     3s
Validation | Loss:     1.0840 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.2739 | Accuracy:  91.0589% | Elapsed:     3s
Validation | Loss:     1.1546 | Accuracy:  71.7599% | Elapsed:     1s
Epoch 00036: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.2309 | Accuracy:  93.0367% | Elapsed:     3s
Validation | Loss:     1.1450 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.2213 | Accuracy:  93.1191% | Elapsed:     3s
Validation | Loss:     1.1405 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.2167 | Accuracy:  93.4899% | Elapsed:     4s
Validation | Loss:     1.1342 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.2138 | Accuracy:  93.5723% | Elapsed:     4s
Validation | Loss:     1.1310 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.2115 | Accuracy:  93.6959% | Elapsed:     3s
Validation | Loss:     1.1314 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.2089 | Accuracy:  93.8607% | Elapsed:     3s
Validation | Loss:     1.1400 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.2060 | Accuracy:  93.8195% | Elapsed:     3s
Validation | Loss:     1.1397 | Accuracy:  71.6235% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2031 | Accuracy:  94.0667% | Elapsed:     4s
Validation | Loss:     1.1456 | Accuracy:  71.6235% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 45/75
Training   | Loss:     0.2014 | Accuracy:  94.1904% | Elapsed:     3s
Validation | Loss:     1.1500 | Accuracy:  71.8963% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.1992 | Accuracy:  94.1080% | Elapsed:     3s
Validation | Loss:     1.1613 | Accuracy:  71.8963% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.1971 | Accuracy:  94.3552% | Elapsed:     3s
Validation | Loss:     1.1715 | Accuracy:  71.6235% | Elapsed:     1s
Epoch 00047: reducing learning rate of group 0 to 1.0000e-06.
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.1940 | Accuracy:  94.3552% | Elapsed:     3s
Validation | Loss:     1.1710 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.1938 | Accuracy:  94.3552% | Elapsed:     3s
Validation | Loss:     1.1713 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.1934 | Accuracy:  94.3964% | Elapsed:     3s
Validation | Loss:     1.1713 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.1931 | Accuracy:  94.3964% | Elapsed:     3s
Validation | Loss:     1.1724 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.1929 | Accuracy:  94.4376% | Elapsed:     3s
Validation | Loss:     1.1730 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.1926 | Accuracy:  94.4788% | Elapsed:     3s
Validation | Loss:     1.1735 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.1923 | Accuracy:  94.4788% | Elapsed:     3s
Validation | Loss:     1.1739 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1919 | Accuracy:  94.4788% | Elapsed:     3s
Validation | Loss:     1.1751 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1916 | Accuracy:  94.5200% | Elapsed:     3s
Validation | Loss:     1.1768 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1913 | Accuracy:  94.5200% | Elapsed:     3s
Validation | Loss:     1.1787 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1910 | Accuracy:  94.5200% | Elapsed:     3s
Validation | Loss:     1.1798 | Accuracy:  71.6235% | Elapsed:     1s
Epoch 00058: reducing learning rate of group 0 to 1.0000e-07.
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1906 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1800 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1906 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1803 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1906 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1804 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1905 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1807 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1905 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1808 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1905 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1810 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1905 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1812 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1904 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1815 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
```

```
Training   | Loss:     0.1904 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1816 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1904 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1818 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1904 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1820 | Accuracy:  71.6235% | Elapsed:     1s
Epoch 00069: reducing learning rate of group 0 to 1.0000e-08.
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1903 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     1.1820 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1903 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     1.1820 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1903 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     1.1820 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1903 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     1.1821 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1903 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     1.1821 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1903 | Accuracy:  94.5612% | Elapsed:     3s
Validation | Loss:     1.1821 | Accuracy:  71.6235% | Elapsed:     1s
===========================================================================
Training complete in 5m 4s
Best model accuracy:  71.90%
===========================================================================
|
|
|
|
|

===========================================================================
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:     1.9079 | Accuracy:  26.8232% | Elapsed:     3s
Validation | Loss:     1.9650 | Accuracy:  34.5157% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5602 | Accuracy:  41.1207% | Elapsed:     3s
Validation | Loss:     1.6931 | Accuracy:  35.1978% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4408 | Accuracy:  45.6119% | Elapsed:     3s
Validation | Loss:     1.7379 | Accuracy:  39.8363% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.3240 | Accuracy:  49.3201% | Elapsed:     3s
Validation | Loss:     1.5323 | Accuracy:  47.0668% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.3061 | Accuracy:  51.3803% | Elapsed:     3s
Validation | Loss:     1.5493 | Accuracy:  45.0205% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.2711 | Accuracy:  52.6576% | Elapsed:     4s
Validation | Loss:     1.5214 | Accuracy:  49.9318% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.1461 | Accuracy:  56.4895% | Elapsed:     4s
Validation | Loss:     1.3776 | Accuracy:  51.0232% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.1104 | Accuracy:  58.7969% | Elapsed:     4s
Validation | Loss:     1.3356 | Accuracy:  53.0696% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.1071 | Accuracy:  59.8681% | Elapsed:     4s
Validation | Loss:     1.4643 | Accuracy:  50.8868% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.0223 | Accuracy:  61.9695% | Elapsed:     3s
Validation | Loss:     1.2493 | Accuracy:  56.3438% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.9450 | Accuracy:  66.7079% | Elapsed:     4s
Validation | Loss:     1.2237 | Accuracy:  62.7558% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.9153 | Accuracy:  68.0264% | Elapsed:     4s
Validation | Loss:     1.1604 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.9908 | Accuracy:  64.7713% | Elapsed:     3s
Validation | Loss:     1.5150 | Accuracy:  51.9782% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.8949 | Accuracy:  68.9740% | Elapsed:     3s
Validation | Loss:     1.2443 | Accuracy:  56.6166% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.7809 | Accuracy:  71.9819% | Elapsed:     3s
Validation | Loss:     1.1968 | Accuracy:  62.7558% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.7912 | Accuracy:  72.1055% | Elapsed:     3s
Validation | Loss:     1.2067 | Accuracy:  60.4366% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.7781 | Accuracy:  72.0231% | Elapsed:     3s
Validation | Loss:     1.0701 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.7452 | Accuracy:  75.1133% | Elapsed:     3s
Validation | Loss:     1.7723 | Accuracy:  41.4734% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.8325 | Accuracy:  70.3337% | Elapsed:     3s
Validation | Loss:     1.3253 | Accuracy:  58.2538% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.7655 | Accuracy:  73.6712% | Elapsed:     3s
Validation | Loss:     1.2392 | Accuracy:  57.7080% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.7424 | Accuracy:  74.6601% | Elapsed:     3s
Validation | Loss:     1.1908 | Accuracy:  65.0750% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.7226 | Accuracy:  75.6902% | Elapsed:     3s
Validation | Loss:     1.0621 | Accuracy:  67.8035% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6625 | Accuracy:  76.7202% | Elapsed:     3s
Validation | Loss:     1.0966 | Accuracy:  67.2578% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.6458 | Accuracy:  78.3684% | Elapsed:     3s
Validation | Loss:     0.8995 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.7303 | Accuracy:  74.6601% | Elapsed:     3s
Validation | Loss:     1.0188 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.6914 | Accuracy:  76.8438% | Elapsed:     3s
Validation | Loss:     1.1335 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.6908 | Accuracy:  76.3906% | Elapsed:     3s
Validation | Loss:     1.0502 | Accuracy:  69.4407% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.6481 | Accuracy:  78.2859% | Elapsed:     3s
Validation | Loss:     0.9647 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.6577 | Accuracy:  76.7202% | Elapsed:     3s
Validation | Loss:     1.1753 | Accuracy:  65.4843% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.6345 | Accuracy:  78.6980% | Elapsed:     4s
Validation | Loss:     0.9180 | Accuracy:  72.4420% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.6094 | Accuracy:  79.1924% | Elapsed:     4s
Validation | Loss:     0.9946 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.6673 | Accuracy:  77.2559% | Elapsed:     4s
```

```
Validation | Loss:     1.1576 | Accuracy:  63.3015% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.7020 | Accuracy:  75.6489% | Elapsed:     4s
Validation | Loss:     1.0937 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.5298 | Accuracy:  82.8183% | Elapsed:     4s
Validation | Loss:     1.3701 | Accuracy:  62.0737% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.5248 | Accuracy:  82.1590% | Elapsed:     3s
Validation | Loss:     0.9519 | Accuracy:  73.6698% | Elapsed:     1s
Epoch 00035: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.3888 | Accuracy:  88.3395% | Elapsed:     4s
Validation | Loss:     1.0752 | Accuracy:  70.1228% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3332 | Accuracy:  90.1112% | Elapsed:     3s
Validation | Loss:     1.0975 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3182 | Accuracy:  89.9876% | Elapsed:     3s
Validation | Loss:     1.1863 | Accuracy:  68.7585% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3033 | Accuracy:  90.9765% | Elapsed:     3s
Validation | Loss:     1.3118 | Accuracy:  66.8486% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.2925 | Accuracy:  90.7705% | Elapsed:     3s
Validation | Loss:     1.1269 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.2810 | Accuracy:  91.2649% | Elapsed:     3s
Validation | Loss:     1.1022 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.2741 | Accuracy:  91.3885% | Elapsed:     4s
Validation | Loss:     1.2108 | Accuracy:  70.5321% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.2655 | Accuracy:  91.8418% | Elapsed:     4s
Validation | Loss:     1.2589 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2545 | Accuracy:  91.9242% | Elapsed:     3s
Validation | Loss:     1.2727 | Accuracy:  70.9413% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2416 | Accuracy:  92.3774% | Elapsed:     3s
Validation | Loss:     1.2095 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2417 | Accuracy:  92.5010% | Elapsed:     3s
Validation | Loss:     1.2500 | Accuracy:  71.2142% | Elapsed:     1s
Epoch 00046: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2177 | Accuracy:  93.6135% | Elapsed:     4s
Validation | Loss:     1.2735 | Accuracy:  71.4870% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2129 | Accuracy:  93.6959% | Elapsed:     4s
Validation | Loss:     1.2769 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2100 | Accuracy:  93.6135% | Elapsed:     4s
Validation | Loss:     1.2653 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2079 | Accuracy:  93.7783% | Elapsed:     4s
Validation | Loss:     1.2851 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2050 | Accuracy:  93.9431% | Elapsed:     3s
Validation | Loss:     1.3076 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2029 | Accuracy:  93.9843% | Elapsed:     3s
Validation | Loss:     1.3027 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2004 | Accuracy:  94.2316% | Elapsed:     3s
Validation | Loss:     1.3018 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.1981 | Accuracy:  94.2728% | Elapsed:     3s
Validation | Loss:     1.3194 | Accuracy:  71.0778% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1963 | Accuracy:  94.4376% | Elapsed:     3s
Validation | Loss:     1.3188 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1935 | Accuracy:  94.3964% | Elapsed:     4s
Validation | Loss:     1.3258 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1917 | Accuracy:  94.5612% | Elapsed:     4s
Validation | Loss:     1.3358 | Accuracy:  71.3506% | Elapsed:     1s
Epoch 00057: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1879 | Accuracy:  94.6848% | Elapsed:     3s
Validation | Loss:     1.3377 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1874 | Accuracy:  94.6848% | Elapsed:     3s
Validation | Loss:     1.3401 | Accuracy:  71.0778% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1870 | Accuracy:  94.6436% | Elapsed:     3s
Validation | Loss:     1.3408 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1867 | Accuracy:  94.6848% | Elapsed:     3s
Validation | Loss:     1.3398 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1865 | Accuracy:  94.6848% | Elapsed:     3s
Validation | Loss:     1.3410 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1862 | Accuracy:  94.6848% | Elapsed:     3s
Validation | Loss:     1.3425 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1859 | Accuracy:  94.6848% | Elapsed:     3s
Validation | Loss:     1.3438 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1856 | Accuracy:  94.7260% | Elapsed:     3s
Validation | Loss:     1.3448 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1854 | Accuracy:  94.7260% | Elapsed:     3s
Validation | Loss:     1.3455 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1851 | Accuracy:  94.7672% | Elapsed:     3s
Validation | Loss:     1.3437 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1848 | Accuracy:  94.7672% | Elapsed:     3s
Validation | Loss:     1.3443 | Accuracy:  71.3506% | Elapsed:     1s
Epoch 00068: reducing learning rate of group 0 to 1.0000e-07.
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1844 | Accuracy:  94.7672% | Elapsed:     3s
Validation | Loss:     1.3444 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1843 | Accuracy:  94.7672% | Elapsed:     4s
Validation | Loss:     1.3447 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1843 | Accuracy:  94.7672% | Elapsed:     3s
Validation | Loss:     1.3447 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1843 | Accuracy:  94.7672% | Elapsed:     4s
Validation | Loss:     1.3448 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1843 | Accuracy:  94.7672% | Elapsed:     3s
Validation | Loss:     1.3450 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1842 | Accuracy:  94.7672% | Elapsed:     4s
Validation | Loss:     1.3451 | Accuracy:  71.3506% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1842 | Accuracy:  94.7672% | Elapsed:     4s
Validation | Loss:     1.3452 | Accuracy:  71.3506% | Elapsed:     1s
================================================================================
Training complete in 5m 7s
Best model accuracy:  73.67%
================================================================================
|
```

|
|
|
|

```
================================================================================
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:     1.9635 | Accuracy:  22.2085% | Elapsed:     3s
Validation | Loss:     1.9498 | Accuracy:  18.8267% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.7967 | Accuracy:  29.9547% | Elapsed:     3s
Validation | Loss:     1.8590 | Accuracy:  30.5593% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.6198 | Accuracy:  38.1129% | Elapsed:     3s
Validation | Loss:     1.6032 | Accuracy:  45.1569% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.5272 | Accuracy:  42.2332% | Elapsed:     4s
Validation | Loss:     1.7265 | Accuracy:  37.5171% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.4949 | Accuracy:  44.4994% | Elapsed:     3s
Validation | Loss:     1.6772 | Accuracy:  38.8813% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.4754 | Accuracy:  44.0874% | Elapsed:     3s
Validation | Loss:     1.6646 | Accuracy:  38.6085% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.4130 | Accuracy:  47.3424% | Elapsed:     3s
Validation | Loss:     1.7729 | Accuracy:  40.3820% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.3429 | Accuracy:  49.1141% | Elapsed:     4s
Validation | Loss:     1.6182 | Accuracy:  38.1992% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.3915 | Accuracy:  47.4248% | Elapsed:     3s
Validation | Loss:     1.5253 | Accuracy:  39.9727% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.4974 | Accuracy:  42.4804% | Elapsed:     3s
Validation | Loss:     1.7063 | Accuracy:  35.7435% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.8255 | Accuracy:  31.8088% | Elapsed:     3s
Validation | Loss:     1.9766 | Accuracy:  29.3315% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.6322 | Accuracy:  38.5249% | Elapsed:     3s
Validation | Loss:     1.6164 | Accuracy:  42.5648% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.4817 | Accuracy:  44.7054% | Elapsed:     4s
Validation | Loss:     3.0408 | Accuracy:  15.4161% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.6637 | Accuracy:  37.4536% | Elapsed:     4s
Validation | Loss:     1.6425 | Accuracy:  41.2005% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.4784 | Accuracy:  43.6341% | Elapsed:     3s
Validation | Loss:     1.5566 | Accuracy:  41.6098% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.6003 | Accuracy:  39.2254% | Elapsed:     3s
Validation | Loss:     1.5486 | Accuracy:  43.1105% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.3498 | Accuracy:  48.4549% | Elapsed:     3s
Validation | Loss:     1.5825 | Accuracy:  43.3834% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.3341 | Accuracy:  48.7433% | Elapsed:     4s
Validation | Loss:     1.4833 | Accuracy:  44.0655% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.3067 | Accuracy:  51.1743% | Elapsed:     3s
Validation | Loss:     1.6076 | Accuracy:  46.5211% | Elapsed:     1s
```

```
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.4536 | Accuracy:  44.4170% | Elapsed:     3s
Validation | Loss:     1.6208 | Accuracy:  40.3820% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.3028 | Accuracy:  50.4326% | Elapsed:     4s
Validation | Loss:     1.4396 | Accuracy:  48.5675% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.4101 | Accuracy:  47.6720% | Elapsed:     3s
Validation | Loss:     1.7925 | Accuracy:  24.0109% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.6314 | Accuracy:  37.7009% | Elapsed:     3s
Validation | Loss:     1.7679 | Accuracy:  30.2865% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.7542 | Accuracy:  31.9324% | Elapsed:     4s
Validation | Loss:     1.8553 | Accuracy:  31.1050% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.6113 | Accuracy:  36.8356% | Elapsed:     3s
Validation | Loss:     1.8340 | Accuracy:  32.8786% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.4991 | Accuracy:  42.3568% | Elapsed:     3s
Validation | Loss:     1.6050 | Accuracy:  44.3383% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.3651 | Accuracy:  48.9493% | Elapsed:     3s
Validation | Loss:     1.7383 | Accuracy:  36.5621% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     1.3728 | Accuracy:  47.3836% | Elapsed:     4s
Validation | Loss:     1.6426 | Accuracy:  36.9714% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.4479 | Accuracy:  43.6753% | Elapsed:     3s
Validation | Loss:     1.6270 | Accuracy:  36.1528% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.5136 | Accuracy:  43.2221% | Elapsed:     4s
Validation | Loss:     1.5386 | Accuracy:  41.2005% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.4196 | Accuracy:  44.7466% | Elapsed:     3s
Validation | Loss:     1.5298 | Accuracy:  45.2933% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     1.5068 | Accuracy:  41.4916% | Elapsed:     3s
Validation | Loss:     1.6497 | Accuracy:  38.8813% | Elapsed:     1s
Epoch 00032: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     1.2697 | Accuracy:  51.7923% | Elapsed:     4s
Validation | Loss:     1.5631 | Accuracy:  43.1105% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     1.1927 | Accuracy:  55.5006% | Elapsed:     4s
Validation | Loss:     1.3658 | Accuracy:  48.8404% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.1499 | Accuracy:  58.4260% | Elapsed:     3s
Validation | Loss:     1.4357 | Accuracy:  47.0668% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     1.1157 | Accuracy:  58.4672% | Elapsed:     3s
Validation | Loss:     1.4655 | Accuracy:  46.9304% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     1.0801 | Accuracy:  60.8158% | Elapsed:     3s
Validation | Loss:     1.3632 | Accuracy:  52.3874% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     1.0761 | Accuracy:  60.6510% | Elapsed:     3s
Validation | Loss:     1.3515 | Accuracy:  54.4338% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     1.0468 | Accuracy:  61.8459% | Elapsed:     3s
Validation | Loss:     1.3251 | Accuracy:  52.5239% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     1.0157 | Accuracy:  63.7824% | Elapsed:     3s
Validation | Loss:     1.4145 | Accuracy:  52.9332% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     1.0049 | Accuracy:  63.7000% | Elapsed:     4s
Validation | Loss:     1.2745 | Accuracy:  56.3438% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
```

```
Training   | Loss:     1.0044 | Accuracy:  63.6588% | Elapsed:     4s
Validation | Loss:     1.2849 | Accuracy:  54.8431% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.9940 | Accuracy:  63.1232% | Elapsed:     4s
Validation | Loss:     1.4140 | Accuracy:  50.4775% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.9530 | Accuracy:  65.7190% | Elapsed:     4s
Validation | Loss:     1.2750 | Accuracy:  57.7080% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9340 | Accuracy:  66.2134% | Elapsed:     4s
Validation | Loss:     1.2898 | Accuracy:  57.8445% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.9498 | Accuracy:  64.1533% | Elapsed:     4s
Validation | Loss:     1.2596 | Accuracy:  55.2524% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.9161 | Accuracy:  67.2023% | Elapsed:     4s
Validation | Loss:     1.1641 | Accuracy:  58.2538% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.9014 | Accuracy:  68.4796% | Elapsed:     3s
Validation | Loss:     1.2862 | Accuracy:  56.2074% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.8948 | Accuracy:  68.4384% | Elapsed:     4s
Validation | Loss:     1.3061 | Accuracy:  53.6153% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.8944 | Accuracy:  68.6856% | Elapsed:     3s
Validation | Loss:     1.2145 | Accuracy:  58.2538% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.8671 | Accuracy:  69.9217% | Elapsed:     3s
Validation | Loss:     1.2021 | Accuracy:  57.7080% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.8743 | Accuracy:  69.8805% | Elapsed:     3s
Validation | Loss:     1.3535 | Accuracy:  53.2060% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.9244 | Accuracy:  67.2847% | Elapsed:     3s
Validation | Loss:     1.2412 | Accuracy:  58.6630% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.8375 | Accuracy:  70.7870% | Elapsed:     4s
Validation | Loss:     1.2296 | Accuracy:  61.1187% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.8063 | Accuracy:  72.8883% | Elapsed:     3s
Validation | Loss:     1.1740 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.8439 | Accuracy:  70.2513% | Elapsed:     3s
Validation | Loss:     1.1528 | Accuracy:  55.9345% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.9120 | Accuracy:  68.3560% | Elapsed:     3s
Validation | Loss:     1.2463 | Accuracy:  58.1173% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.8258 | Accuracy:  72.1879% | Elapsed:     3s
Validation | Loss:     1.2158 | Accuracy:  59.3452% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.8038 | Accuracy:  72.6411% | Elapsed:     3s
Validation | Loss:     1.4361 | Accuracy:  52.5239% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.8218 | Accuracy:  71.0754% | Elapsed:     3s
Validation | Loss:     1.2331 | Accuracy:  59.7544% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.8940 | Accuracy:  69.3037% | Elapsed:     4s
Validation | Loss:     1.2021 | Accuracy:  61.2551% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.8806 | Accuracy:  69.3449% | Elapsed:     3s
Validation | Loss:     1.2581 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.8125 | Accuracy:  72.1055% | Elapsed:     3s
Validation | Loss:     1.2192 | Accuracy:  60.8458% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.9068 | Accuracy:  68.5208% | Elapsed:     3s
Validation | Loss:     1.3194 | Accuracy:  55.7981% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 65/75
Training   | Loss:     0.8103 | Accuracy:  73.6712% | Elapsed:     3s
Validation | Loss:     1.1578 | Accuracy:  63.7108% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.8118 | Accuracy:  73.0119% | Elapsed:     4s
Validation | Loss:     1.3323 | Accuracy:  53.8881% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.8244 | Accuracy:  71.9407% | Elapsed:     4s
Validation | Loss:     1.1594 | Accuracy:  57.4352% | Elapsed:     1s
Epoch 00067: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.7465 | Accuracy:  75.5253% | Elapsed:     3s
Validation | Loss:     1.1520 | Accuracy:  60.3001% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.7332 | Accuracy:  76.2670% | Elapsed:     3s
Validation | Loss:     1.1627 | Accuracy:  60.8458% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.7292 | Accuracy:  75.8550% | Elapsed:     3s
Validation | Loss:     1.1519 | Accuracy:  61.1187% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.7208 | Accuracy:  76.2258% | Elapsed:     4s
Validation | Loss:     1.1349 | Accuracy:  61.6644% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.7146 | Accuracy:  77.1735% | Elapsed:     3s
Validation | Loss:     1.1349 | Accuracy:  61.5280% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.7127 | Accuracy:  77.7503% | Elapsed:     4s
Validation | Loss:     1.1112 | Accuracy:  62.7558% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.7059 | Accuracy:  77.6267% | Elapsed:     3s
Validation | Loss:     1.1444 | Accuracy:  60.9823% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.7014 | Accuracy:  77.8327% | Elapsed:     3s
Validation | Loss:     1.1138 | Accuracy:  62.7558% | Elapsed:     1s
===========================================================================
Training complete in 5m 6s
Best model accuracy:  63.71%
===========================================================================
|
|
|
|
|

===========================================================================
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:     1.9303 | Accuracy:  28.3478% | Elapsed:     3s
Validation | Loss:     1.8603 | Accuracy:  32.8786% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5265 | Accuracy:  45.5295% | Elapsed:     3s
Validation | Loss:     1.5614 | Accuracy:  42.5648% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.2903 | Accuracy:  54.0173% | Elapsed:     3s
Validation | Loss:     1.4788 | Accuracy:  50.0682% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.1516 | Accuracy:  59.4561% | Elapsed:     3s
Validation | Loss:     1.3046 | Accuracy:  56.0709% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.0449 | Accuracy:  63.9885% | Elapsed:     3s
Validation | Loss:     1.4852 | Accuracy:  47.3397% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     0.9949 | Accuracy:  64.0709% | Elapsed:     3s
Validation | Loss:     1.2907 | Accuracy:  54.4338% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.9243 | Accuracy:  67.9028% | Elapsed:     3s
```

```
Validation | Loss:     1.2642 | Accuracy:  54.8431% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.8496 | Accuracy:  71.4050% | Elapsed:     3s
Validation | Loss:     1.1910 | Accuracy:  56.0709% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.7744 | Accuracy:  74.4129% | Elapsed:     3s
Validation | Loss:     1.1304 | Accuracy:  61.8008% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.7370 | Accuracy:  75.9374% | Elapsed:     4s
Validation | Loss:     1.2355 | Accuracy:  56.2074% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.6895 | Accuracy:  77.9563% | Elapsed:     3s
Validation | Loss:     1.0567 | Accuracy:  64.3929% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.6461 | Accuracy:  80.2225% | Elapsed:     3s
Validation | Loss:     1.0384 | Accuracy:  67.8035% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.6326 | Accuracy:  79.9341% | Elapsed:     3s
Validation | Loss:     0.9785 | Accuracy:  66.9850% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.6114 | Accuracy:  81.0466% | Elapsed:     3s
Validation | Loss:     0.9125 | Accuracy:  69.5771% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.5819 | Accuracy:  82.3651% | Elapsed:     3s
Validation | Loss:     1.0956 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.5130 | Accuracy:  85.1669% | Elapsed:     3s
Validation | Loss:     1.1063 | Accuracy:  59.8909% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.5155 | Accuracy:  84.7960% | Elapsed:     3s
Validation | Loss:     0.9536 | Accuracy:  66.7121% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.4641 | Accuracy:  86.8562% | Elapsed:     3s
Validation | Loss:     0.9507 | Accuracy:  66.8486% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.4531 | Accuracy:  86.3618% | Elapsed:     3s
Validation | Loss:     1.0138 | Accuracy:  67.5307% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.4778 | Accuracy:  86.0321% | Elapsed:     3s
Validation | Loss:     0.9137 | Accuracy:  67.8035% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.4601 | Accuracy:  87.2270% | Elapsed:     3s
Validation | Loss:     0.9146 | Accuracy:  69.5771% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.4495 | Accuracy:  87.1858% | Elapsed:     3s
Validation | Loss:     0.8455 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.4496 | Accuracy:  86.7738% | Elapsed:     3s
Validation | Loss:     0.8976 | Accuracy:  69.1678% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.4756 | Accuracy:  85.6613% | Elapsed:     3s
Validation | Loss:     0.9844 | Accuracy:  66.0300% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.4246 | Accuracy:  87.4330% | Elapsed:     3s
Validation | Loss:     0.8916 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.4004 | Accuracy:  88.7927% | Elapsed:     3s
Validation | Loss:     1.1832 | Accuracy:  60.0273% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.4172 | Accuracy:  87.8863% | Elapsed:     3s
Validation | Loss:     0.9364 | Accuracy:  68.0764% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.4116 | Accuracy:  88.7103% | Elapsed:     3s
Validation | Loss:     0.9250 | Accuracy:  68.8950% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.4045 | Accuracy:  88.3395% | Elapsed:     3s
Validation | Loss:     0.8847 | Accuracy:  69.4407% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
```

```
Training   | Loss:     0.3883 | Accuracy:  88.8752% | Elapsed:     3s
Validation | Loss:     1.0308 | Accuracy:  63.5744% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.3957 | Accuracy:  89.2872% | Elapsed:     3s
Validation | Loss:     1.1331 | Accuracy:  66.9850% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.3718 | Accuracy:  89.6992% | Elapsed:     3s
Validation | Loss:     1.0320 | Accuracy:  64.9386% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.3954 | Accuracy:  88.4631% | Elapsed:     3s
Validation | Loss:     0.9757 | Accuracy:  66.9850% | Elapsed:     1s
Epoch 00033: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.3077 | Accuracy:  91.6770% | Elapsed:     3s
Validation | Loss:     0.8290 | Accuracy:  71.8963% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.2685 | Accuracy:  93.5311% | Elapsed:     3s
Validation | Loss:     0.8395 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.2578 | Accuracy:  93.9431% | Elapsed:     3s
Validation | Loss:     0.8736 | Accuracy:  70.8049% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.2538 | Accuracy:  93.7783% | Elapsed:     3s
Validation | Loss:     0.8064 | Accuracy:  73.6698% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.2438 | Accuracy:  94.3964% | Elapsed:     3s
Validation | Loss:     0.8209 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.2374 | Accuracy:  94.4788% | Elapsed:     3s
Validation | Loss:     0.8121 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.2317 | Accuracy:  94.7260% | Elapsed:     3s
Validation | Loss:     0.7863 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.2243 | Accuracy:  95.0144% | Elapsed:     3s
Validation | Loss:     0.7890 | Accuracy:  71.7599% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.2193 | Accuracy:  94.9320% | Elapsed:     3s
Validation | Loss:     0.7797 | Accuracy:  72.8513% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.2161 | Accuracy:  95.0144% | Elapsed:     3s
Validation | Loss:     0.7999 | Accuracy:  72.8513% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2125 | Accuracy:  95.0556% | Elapsed:     3s
Validation | Loss:     0.7939 | Accuracy:  73.1241% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2072 | Accuracy:  95.5501% | Elapsed:     3s
Validation | Loss:     0.8208 | Accuracy:  70.5321% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2034 | Accuracy:  95.5501% | Elapsed:     3s
Validation | Loss:     0.8031 | Accuracy:  73.2606% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.1960 | Accuracy:  95.8385% | Elapsed:     3s
Validation | Loss:     0.8560 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.1924 | Accuracy:  95.5089% | Elapsed:     3s
Validation | Loss:     0.8228 | Accuracy:  71.3506% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.1865 | Accuracy:  95.6737% | Elapsed:     3s
Validation | Loss:     0.8062 | Accuracy:  72.9877% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.1812 | Accuracy:  95.8797% | Elapsed:     3s
Validation | Loss:     0.7864 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.1776 | Accuracy:  95.9621% | Elapsed:     3s
Validation | Loss:     0.8122 | Accuracy:  73.2606% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.1745 | Accuracy:  96.1681% | Elapsed:     3s
Validation | Loss:     0.8161 | Accuracy:  73.1241% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.1654 | Accuracy:  96.2093% | Elapsed:     3s
Validation | Loss:     0.8262 | Accuracy:  73.1241% | Elapsed:     1s
Epoch 00053: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.1497 | Accuracy:  97.1158% | Elapsed:     3s
Validation | Loss:     0.8058 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1470 | Accuracy:  97.1158% | Elapsed:     3s
Validation | Loss:     0.8021 | Accuracy:  73.3970% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1456 | Accuracy:  97.3218% | Elapsed:     3s
Validation | Loss:     0.8039 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1446 | Accuracy:  97.1570% | Elapsed:     3s
Validation | Loss:     0.8083 | Accuracy:  73.3970% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1434 | Accuracy:  97.2806% | Elapsed:     3s
Validation | Loss:     0.8038 | Accuracy:  73.6698% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1425 | Accuracy:  97.3630% | Elapsed:     3s
Validation | Loss:     0.8048 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1416 | Accuracy:  97.2394% | Elapsed:     3s
Validation | Loss:     0.8058 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1405 | Accuracy:  97.3218% | Elapsed:     3s
Validation | Loss:     0.8099 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1395 | Accuracy:  97.3630% | Elapsed:     4s
Validation | Loss:     0.8046 | Accuracy:  73.8063% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1380 | Accuracy:  97.4866% | Elapsed:     5s
Validation | Loss:     0.8053 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1371 | Accuracy:  97.3630% | Elapsed:     5s
Validation | Loss:     0.8123 | Accuracy:  73.6698% | Elapsed:     1s
Epoch 00064: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1346 | Accuracy:  97.4866% | Elapsed:     5s
Validation | Loss:     0.8117 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1342 | Accuracy:  97.4866% | Elapsed:     5s
Validation | Loss:     0.8116 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1339 | Accuracy:  97.4866% | Elapsed:     5s
Validation | Loss:     0.8113 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1336 | Accuracy:  97.4866% | Elapsed:     5s
Validation | Loss:     0.8113 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1334 | Accuracy:  97.4866% | Elapsed:     5s
Validation | Loss:     0.8112 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1333 | Accuracy:  97.5278% | Elapsed:     5s
Validation | Loss:     0.8117 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1331 | Accuracy:  97.5278% | Elapsed:     5s
Validation | Loss:     0.8116 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1330 | Accuracy:  97.5278% | Elapsed:     5s
Validation | Loss:     0.8116 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1328 | Accuracy:  97.5278% | Elapsed:     5s
Validation | Loss:     0.8119 | Accuracy:  74.0791% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1326 | Accuracy:  97.5278% | Elapsed:     5s
Validation | Loss:     0.8122 | Accuracy:  74.2156% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 75/75
Training   | Loss:     0.1325 | Accuracy:  97.5278% | Elapsed:     5s
Validation | Loss:     0.8118 | Accuracy:  74.0791% | Elapsed:     1s
Epoch 00075: reducing learning rate of group 0 to 1.0000e-07.
================================================================================
Training complete in 5m 3s
Best model accuracy:  74.22%
================================================================================
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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:     1.9267 | Accuracy:  29.2130% | Elapsed:     4s
Validation | Loss:     1.7627 | Accuracy:  40.7913% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5516 | Accuracy:  45.3646% | Elapsed:     4s
Validation | Loss:     1.5886 | Accuracy:  44.3383% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.3521 | Accuracy:  51.6687% | Elapsed:     4s
Validation | Loss:     1.4216 | Accuracy:  49.5225% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2050 | Accuracy:  58.7557% | Elapsed:     3s
Validation | Loss:     1.3655 | Accuracy:  52.7967% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1228 | Accuracy:  61.8871% | Elapsed:     3s
Validation | Loss:     1.2930 | Accuracy:  53.2060% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.0422 | Accuracy:  66.0486% | Elapsed:     3s
Validation | Loss:     1.2065 | Accuracy:  53.6153% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     0.9645 | Accuracy:  67.0787% | Elapsed:     3s
Validation | Loss:     1.2270 | Accuracy:  55.7981% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9109 | Accuracy:  70.0865% | Elapsed:     3s
Validation | Loss:     1.3275 | Accuracy:  53.8881% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     0.8559 | Accuracy:  72.5999% | Elapsed:     3s
Validation | Loss:     1.1871 | Accuracy:  55.5252% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.8275 | Accuracy:  72.7235% | Elapsed:     3s
Validation | Loss:     1.0673 | Accuracy:  64.9386% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.8071 | Accuracy:  74.2480% | Elapsed:     3s
Validation | Loss:     1.0261 | Accuracy:  64.2565% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.7680 | Accuracy:  74.8249% | Elapsed:     3s
Validation | Loss:     1.0665 | Accuracy:  66.0300% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.7185 | Accuracy:  77.6267% | Elapsed:     3s
Validation | Loss:     0.9731 | Accuracy:  65.3479% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.6965 | Accuracy:  79.6044% | Elapsed:     3s
Validation | Loss:     1.0232 | Accuracy:  63.4379% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.6547 | Accuracy:  80.8405% | Elapsed:     3s
Validation | Loss:     1.0769 | Accuracy:  61.8008% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.6510 | Accuracy:  81.0878% | Elapsed:     3s
Validation | Loss:     1.0264 | Accuracy:  66.5757% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.6424 | Accuracy:  80.4285% | Elapsed:     3s
```

```
Validation | Loss:     0.9756 | Accuracy:  67.2578% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.6195 | Accuracy:  82.5299% | Elapsed:     3s
Validation | Loss:     1.0530 | Accuracy:  68.7585% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.6419 | Accuracy:  80.9230% | Elapsed:     3s
Validation | Loss:     1.0347 | Accuracy:  67.2578% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.5939 | Accuracy:  82.9831% | Elapsed:     3s
Validation | Loss:     1.0006 | Accuracy:  68.2128% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.5562 | Accuracy:  84.9197% | Elapsed:     3s
Validation | Loss:     0.9167 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.5549 | Accuracy:  83.8072% | Elapsed:     3s
Validation | Loss:     0.9702 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.5137 | Accuracy:  84.5900% | Elapsed:     3s
Validation | Loss:     0.8357 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.5480 | Accuracy:  84.1780% | Elapsed:     3s
Validation | Loss:     0.8534 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5277 | Accuracy:  84.9609% | Elapsed:     3s
Validation | Loss:     0.8514 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.5202 | Accuracy:  85.2905% | Elapsed:     4s
Validation | Loss:     0.9477 | Accuracy:  67.3943% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5054 | Accuracy:  85.7025% | Elapsed:     4s
Validation | Loss:     0.9160 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.5331 | Accuracy:  84.7960% | Elapsed:     4s
Validation | Loss:     0.9261 | Accuracy:  69.0314% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.4953 | Accuracy:  85.3317% | Elapsed:     4s
Validation | Loss:     0.8704 | Accuracy:  69.8499% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.4660 | Accuracy:  86.4030% | Elapsed:     4s
Validation | Loss:     0.8362 | Accuracy:  70.1228% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.5007 | Accuracy:  84.8372% | Elapsed:     5s
Validation | Loss:     0.9989 | Accuracy:  66.1664% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.5190 | Accuracy:  84.0544% | Elapsed:     5s
Validation | Loss:     0.9468 | Accuracy:  67.5307% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.5693 | Accuracy:  83.1891% | Elapsed:     5s
Validation | Loss:     0.8864 | Accuracy:  71.7599% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.5463 | Accuracy:  84.3428% | Elapsed:     5s
Validation | Loss:     0.9385 | Accuracy:  66.9850% | Elapsed:     1s
Epoch 00034: reducing learning rate of group 0 to 1.0000e-04.
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.4423 | Accuracy:  88.8340% | Elapsed:     5s
Validation | Loss:     0.7971 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.4114 | Accuracy:  89.6580% | Elapsed:     5s
Validation | Loss:     0.7748 | Accuracy:  73.6698% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3999 | Accuracy:  90.6057% | Elapsed:     5s
Validation | Loss:     0.7701 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3877 | Accuracy:  91.0177% | Elapsed:     5s
Validation | Loss:     0.7712 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3761 | Accuracy:  90.7705% | Elapsed:     5s
Validation | Loss:     0.7381 | Accuracy:  76.2619% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 40/75
Training   | Loss:     0.3590 | Accuracy:  91.5122% | Elapsed:     5s
Validation | Loss:     0.7646 | Accuracy:  74.6248% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3509 | Accuracy:  91.4710% | Elapsed:     5s
Validation | Loss:     0.7862 | Accuracy:  73.3970% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.3277 | Accuracy:  91.8830% | Elapsed:     5s
Validation | Loss:     0.7570 | Accuracy:  74.3520% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3217 | Accuracy:  92.2538% | Elapsed:     5s
Validation | Loss:     0.7090 | Accuracy:  76.8076% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.3106 | Accuracy:  92.6658% | Elapsed:     5s
Validation | Loss:     0.7184 | Accuracy:  76.3984% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.3071 | Accuracy:  92.9543% | Elapsed:     5s
Validation | Loss:     0.7314 | Accuracy:  76.2619% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.3052 | Accuracy:  93.0367% | Elapsed:     5s
Validation | Loss:     0.7348 | Accuracy:  76.6712% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2999 | Accuracy:  93.1603% | Elapsed:     5s
Validation | Loss:     0.7380 | Accuracy:  75.0341% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2925 | Accuracy:  93.2839% | Elapsed:     5s
Validation | Loss:     0.7246 | Accuracy:  76.5348% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2910 | Accuracy:  93.0779% | Elapsed:     5s
Validation | Loss:     0.7439 | Accuracy:  76.1255% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2826 | Accuracy:  93.4487% | Elapsed:     5s
Validation | Loss:     0.7582 | Accuracy:  74.4884% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2712 | Accuracy:  93.5723% | Elapsed:     5s
Validation | Loss:     0.7846 | Accuracy:  72.9877% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2645 | Accuracy:  93.9843% | Elapsed:     4s
Validation | Loss:     0.7319 | Accuracy:  75.3070% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2573 | Accuracy:  94.2316% | Elapsed:     5s
Validation | Loss:     0.7007 | Accuracy:  75.9891% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2487 | Accuracy:  94.2728% | Elapsed:     5s
Validation | Loss:     0.7539 | Accuracy:  75.7162% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.2426 | Accuracy:  94.1492% | Elapsed:     5s
Validation | Loss:     0.7357 | Accuracy:  75.1705% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.2360 | Accuracy:  94.3964% | Elapsed:     5s
Validation | Loss:     0.6980 | Accuracy:  76.2619% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.2321 | Accuracy:  94.4376% | Elapsed:     5s
Validation | Loss:     0.6845 | Accuracy:  77.6262% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.2285 | Accuracy:  94.6436% | Elapsed:     5s
Validation | Loss:     0.7798 | Accuracy:  74.2156% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.2252 | Accuracy:  94.7672% | Elapsed:     4s
Validation | Loss:     0.7462 | Accuracy:  75.5798% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.2227 | Accuracy:  95.4265% | Elapsed:     4s
Validation | Loss:     0.6960 | Accuracy:  77.3533% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.2176 | Accuracy:  95.3028% | Elapsed:     5s
Validation | Loss:     0.7084 | Accuracy:  76.9441% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.2190 | Accuracy:  95.1792% | Elapsed:     5s
Validation | Loss:     0.7576 | Accuracy:  75.9891% | Elapsed:     1s
```

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--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.2122 | Accuracy:  95.3440% | Elapsed:     5s
Validation | Loss:     0.7569 | Accuracy:  76.1255% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.2076 | Accuracy:  95.0968% | Elapsed:     4s
Validation | Loss:     0.6752 | Accuracy:  77.7626% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.2073 | Accuracy:  95.7149% | Elapsed:     4s
Validation | Loss:     0.6905 | Accuracy:  77.0805% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.2060 | Accuracy:  95.1792% | Elapsed:     5s
Validation | Loss:     0.7279 | Accuracy:  75.8527% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.2030 | Accuracy:  95.5913% | Elapsed:     5s
Validation | Loss:     0.6968 | Accuracy:  77.4898% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1981 | Accuracy:  95.7561% | Elapsed:     5s
Validation | Loss:     0.6899 | Accuracy:  75.9891% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1971 | Accuracy:  95.8385% | Elapsed:     5s
Validation | Loss:     0.7543 | Accuracy:  74.4884% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1976 | Accuracy:  95.9209% | Elapsed:     4s
Validation | Loss:     0.6539 | Accuracy:  77.8990% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1960 | Accuracy:  95.7149% | Elapsed:     5s
Validation | Loss:     0.7316 | Accuracy:  75.4434% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1931 | Accuracy:  95.8385% | Elapsed:     4s
Validation | Loss:     0.7608 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1891 | Accuracy:  95.8797% | Elapsed:     4s
Validation | Loss:     0.7861 | Accuracy:  74.7613% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1843 | Accuracy:  96.2505% | Elapsed:     4s
Validation | Loss:     0.7479 | Accuracy:  75.1705% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1825 | Accuracy:  95.9209% | Elapsed:     4s
Validation | Loss:     0.7491 | Accuracy:  75.8527% | Elapsed:     1s
================================================================================
Training complete in 5m 59s
Best model accuracy:  77.90%
================================================================================
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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:     1.9512 | Accuracy:  27.5237% | Elapsed:     4s
Validation | Loss:     1.9392 | Accuracy:  29.3315% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.7089 | Accuracy:  38.8133% | Elapsed:     5s
Validation | Loss:     1.7632 | Accuracy:  36.5621% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.6233 | Accuracy:  41.2855% | Elapsed:     5s
Validation | Loss:     1.8012 | Accuracy:  34.1064% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.5490 | Accuracy:  44.0049% | Elapsed:     5s
Validation | Loss:     1.6961 | Accuracy:  42.1555% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.4693 | Accuracy:  49.1141% | Elapsed:     5s
```

```
Validation | Loss:     1.7972 | Accuracy:  38.8813% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.4179 | Accuracy:  51.3803% | Elapsed:     5s
Validation | Loss:     1.5877 | Accuracy:  43.9291% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.3868 | Accuracy:  51.1743% | Elapsed:     5s
Validation | Loss:     1.6225 | Accuracy:  43.3834% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.3585 | Accuracy:  53.1108% | Elapsed:     5s
Validation | Loss:     1.5534 | Accuracy:  44.8840% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.3148 | Accuracy:  55.4182% | Elapsed:     4s
Validation | Loss:     1.4850 | Accuracy:  47.3397% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.2772 | Accuracy:  58.5084% | Elapsed:     4s
Validation | Loss:     1.5703 | Accuracy:  44.0655% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.2709 | Accuracy:  57.6432% | Elapsed:     4s
Validation | Loss:     1.5311 | Accuracy:  44.0655% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.2652 | Accuracy:  58.8793% | Elapsed:     5s
Validation | Loss:     1.3920 | Accuracy:  51.9782% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.2382 | Accuracy:  59.7857% | Elapsed:     4s
Validation | Loss:     1.5019 | Accuracy:  46.5211% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.1870 | Accuracy:  61.8459% | Elapsed:     4s
Validation | Loss:     1.3990 | Accuracy:  54.0246% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.1992 | Accuracy:  62.5876% | Elapsed:     4s
Validation | Loss:     1.4067 | Accuracy:  53.3424% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.1867 | Accuracy:  62.5876% | Elapsed:     4s
Validation | Loss:     1.4221 | Accuracy:  54.9795% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.1717 | Accuracy:  63.5352% | Elapsed:     4s
Validation | Loss:     1.3096 | Accuracy:  54.4338% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.1470 | Accuracy:  64.1945% | Elapsed:     4s
Validation | Loss:     1.2947 | Accuracy:  57.9809% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.1159 | Accuracy:  64.8125% | Elapsed:     4s
Validation | Loss:     1.3076 | Accuracy:  57.1623% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.1040 | Accuracy:  65.5542% | Elapsed:     4s
Validation | Loss:     1.4458 | Accuracy:  43.3834% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.1411 | Accuracy:  63.3704% | Elapsed:     5s
Validation | Loss:     1.4283 | Accuracy:  50.8868% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.1322 | Accuracy:  65.3070% | Elapsed:     5s
Validation | Loss:     1.3940 | Accuracy:  57.1623% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.0982 | Accuracy:  66.8727% | Elapsed:     5s
Validation | Loss:     1.3956 | Accuracy:  48.5675% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.0996 | Accuracy:  65.3482% | Elapsed:     5s
Validation | Loss:     1.2858 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.0690 | Accuracy:  67.6967% | Elapsed:     4s
Validation | Loss:     1.2317 | Accuracy:  63.1651% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.0753 | Accuracy:  68.3148% | Elapsed:     4s
Validation | Loss:     1.3372 | Accuracy:  50.3411% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.0683 | Accuracy:  67.6143% | Elapsed:     5s
Validation | Loss:     1.3927 | Accuracy:  53.2060% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
```

```
Training   | Loss:     1.0751 | Accuracy:  67.2023% | Elapsed:     3s
Validation | Loss:     1.2600 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.0585 | Accuracy:  66.6255% | Elapsed:     3s
Validation | Loss:     1.2217 | Accuracy:  57.9809% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.0483 | Accuracy:  68.7680% | Elapsed:     3s
Validation | Loss:     1.2427 | Accuracy:  60.7094% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.0345 | Accuracy:  69.1389% | Elapsed:     3s
Validation | Loss:     1.2536 | Accuracy:  58.6630% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     1.0277 | Accuracy:  69.7981% | Elapsed:     3s
Validation | Loss:     1.2322 | Accuracy:  57.8445% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     1.0593 | Accuracy:  68.7268% | Elapsed:     3s
Validation | Loss:     1.2709 | Accuracy:  59.3452% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     1.0409 | Accuracy:  69.5509% | Elapsed:     3s
Validation | Loss:     1.2905 | Accuracy:  58.6630% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.0327 | Accuracy:  69.5921% | Elapsed:     3s
Validation | Loss:     1.2977 | Accuracy:  55.5252% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     1.0219 | Accuracy:  70.1277% | Elapsed:     3s
Validation | Loss:     1.1833 | Accuracy:  66.1664% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     1.0051 | Accuracy:  70.1689% | Elapsed:     3s
Validation | Loss:     1.2359 | Accuracy:  58.1173% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     1.0135 | Accuracy:  70.8282% | Elapsed:     3s
Validation | Loss:     1.4283 | Accuracy:  49.5225% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     1.0035 | Accuracy:  71.0342% | Elapsed:     3s
Validation | Loss:     1.2925 | Accuracy:  58.7995% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     1.0121 | Accuracy:  71.2814% | Elapsed:     3s
Validation | Loss:     1.2067 | Accuracy:  61.8008% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.9893 | Accuracy:  71.1578% | Elapsed:     3s
Validation | Loss:     1.2165 | Accuracy:  63.1651% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.9672 | Accuracy:  72.0231% | Elapsed:     3s
Validation | Loss:     1.1980 | Accuracy:  63.0286% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.9714 | Accuracy:  72.0231% | Elapsed:     3s
Validation | Loss:     1.1948 | Accuracy:  66.0300% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.9543 | Accuracy:  73.6712% | Elapsed:     3s
Validation | Loss:     1.1815 | Accuracy:  65.3479% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9709 | Accuracy:  71.9407% | Elapsed:     3s
Validation | Loss:     1.1504 | Accuracy:  66.1664% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.9541 | Accuracy:  72.1879% | Elapsed:     3s
Validation | Loss:     1.2400 | Accuracy:  63.3015% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.9629 | Accuracy:  71.5286% | Elapsed:     3s
Validation | Loss:     1.1952 | Accuracy:  61.2551% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.9303 | Accuracy:  73.4652% | Elapsed:     3s
Validation | Loss:     1.1634 | Accuracy:  65.4843% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.9575 | Accuracy:  72.5175% | Elapsed:     3s
Validation | Loss:     1.2094 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.9488 | Accuracy:  72.2291% | Elapsed:     3s
Validation | Loss:     1.2465 | Accuracy:  60.3001% | Elapsed:     1s
---------------------------------------------------------------------------
```

```
Epoch 51/75
Training   | Loss:     0.9303 | Accuracy:  73.5888% | Elapsed:     3s
Validation | Loss:     1.1292 | Accuracy:  64.6658% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.9221 | Accuracy:  73.6300% | Elapsed:     4s
Validation | Loss:     1.1542 | Accuracy:  68.0764% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.9397 | Accuracy:  73.3828% | Elapsed:     4s
Validation | Loss:     1.1314 | Accuracy:  66.4393% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.9233 | Accuracy:  74.6601% | Elapsed:     5s
Validation | Loss:     1.2103 | Accuracy:  64.3929% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.9475 | Accuracy:  74.2892% | Elapsed:     4s
Validation | Loss:     1.3302 | Accuracy:  58.3902% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.9766 | Accuracy:  73.7124% | Elapsed:     5s
Validation | Loss:     1.2967 | Accuracy:  57.1623% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.9631 | Accuracy:  73.9596% | Elapsed:     4s
Validation | Loss:     1.2486 | Accuracy:  59.4816% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.9451 | Accuracy:  74.1656% | Elapsed:     5s
Validation | Loss:     1.2493 | Accuracy:  57.5716% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.9772 | Accuracy:  73.3828% | Elapsed:     5s
Validation | Loss:     1.2080 | Accuracy:  62.6194% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.9512 | Accuracy:  74.4129% | Elapsed:     5s
Validation | Loss:     1.1448 | Accuracy:  69.3042% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     1.0000 | Accuracy:  71.9407% | Elapsed:     5s
Validation | Loss:     1.2735 | Accuracy:  58.6630% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.9549 | Accuracy:  73.4652% | Elapsed:     5s
Validation | Loss:     1.1418 | Accuracy:  65.4843% | Elapsed:     1s
Epoch 00062: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.8530 | Accuracy:  78.7392% | Elapsed:     5s
Validation | Loss:     1.1130 | Accuracy:  67.1214% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.8449 | Accuracy:  78.9040% | Elapsed:     4s
Validation | Loss:     1.1266 | Accuracy:  67.9400% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.8353 | Accuracy:  79.7693% | Elapsed:     5s
Validation | Loss:     1.1250 | Accuracy:  67.5307% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.8319 | Accuracy:  79.6457% | Elapsed:     4s
Validation | Loss:     1.1465 | Accuracy:  65.8936% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.8277 | Accuracy:  79.4396% | Elapsed:     4s
Validation | Loss:     1.1197 | Accuracy:  67.5307% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.8160 | Accuracy:  80.0989% | Elapsed:     4s
Validation | Loss:     1.1051 | Accuracy:  68.0764% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.8077 | Accuracy:  80.7993% | Elapsed:     4s
Validation | Loss:     1.1054 | Accuracy:  69.3042% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.7991 | Accuracy:  80.9230% | Elapsed:     4s
Validation | Loss:     1.0825 | Accuracy:  69.1678% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.7858 | Accuracy:  80.7581% | Elapsed:     4s
Validation | Loss:     1.0536 | Accuracy:  69.4407% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.7783 | Accuracy:  81.2114% | Elapsed:     4s
Validation | Loss:     1.0633 | Accuracy:  68.6221% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.7618 | Accuracy:  81.5822% | Elapsed:     4s
```

```
Validation | Loss:     0.9874 | Accuracy:  73.3970% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.7451 | Accuracy:  82.5299% | Elapsed:     4s
Validation | Loss:     1.0154 | Accuracy:  70.8049% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.7365 | Accuracy:  81.5410% | Elapsed:     4s
Validation | Loss:     1.0306 | Accuracy:  70.5321% | Elapsed:     1s
================================================================================
Training complete in 5m 56s
Best model accuracy:  73.40%
================================================================================
|
|
|
|
|

================================================================================
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:     2.0459 | Accuracy:  20.6428% | Elapsed:     6s
Validation | Loss:     1.8995 | Accuracy:  30.2865% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.6243 | Accuracy:  37.4536% | Elapsed:     6s
Validation | Loss:     1.7620 | Accuracy:  35.7435% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4503 | Accuracy:  43.6341% | Elapsed:     6s
Validation | Loss:     1.4905 | Accuracy:  41.3370% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.3581 | Accuracy:  48.1665% | Elapsed:     6s
Validation | Loss:     1.6138 | Accuracy:  39.1542% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.1866 | Accuracy:  53.0284% | Elapsed:     6s
Validation | Loss:     1.5255 | Accuracy:  45.2933% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.2812 | Accuracy:  50.0206% | Elapsed:     6s
Validation | Loss:     1.3777 | Accuracy:  47.8854% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.2947 | Accuracy:  50.6386% | Elapsed:     6s
Validation | Loss:     1.4905 | Accuracy:  44.8840% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.2176 | Accuracy:  53.4817% | Elapsed:     6s
Validation | Loss:     1.4970 | Accuracy:  47.4761% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.2045 | Accuracy:  55.0886% | Elapsed:     6s
Validation | Loss:     1.5341 | Accuracy:  48.0218% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.0563 | Accuracy:  59.4973% | Elapsed:     5s
Validation | Loss:     1.3531 | Accuracy:  49.5225% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.9374 | Accuracy:  65.0597% | Elapsed:     5s
Validation | Loss:     1.2045 | Accuracy:  56.6166% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.9267 | Accuracy:  65.5130% | Elapsed:     6s
Validation | Loss:     1.0770 | Accuracy:  62.3465% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.9049 | Accuracy:  65.7190% | Elapsed:     5s
Validation | Loss:     0.9858 | Accuracy:  63.5744% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.8579 | Accuracy:  69.0977% | Elapsed:     6s
Validation | Loss:     1.2438 | Accuracy:  57.8445% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.8669 | Accuracy:  68.6856% | Elapsed:     6s
Validation | Loss:     1.1583 | Accuracy:  58.6630% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
```

```
Training   | Loss:     0.7706 | Accuracy:  71.8171% | Elapsed:     6s
Validation | Loss:     0.9792 | Accuracy:  63.8472% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.7571 | Accuracy:  72.1879% | Elapsed:     6s
Validation | Loss:     1.5147 | Accuracy:  56.0709% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.8511 | Accuracy:  70.4574% | Elapsed:     6s
Validation | Loss:     0.9801 | Accuracy:  60.8458% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.7562 | Accuracy:  73.5064% | Elapsed:     6s
Validation | Loss:     0.9372 | Accuracy:  66.4393% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.7034 | Accuracy:  75.1545% | Elapsed:     6s
Validation | Loss:     1.0371 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.6356 | Accuracy:  77.6267% | Elapsed:     6s
Validation | Loss:     0.8779 | Accuracy:  68.8950% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.7063 | Accuracy:  74.9485% | Elapsed:     6s
Validation | Loss:     0.7171 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6248 | Accuracy:  78.3272% | Elapsed:     6s
Validation | Loss:     0.8712 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.5416 | Accuracy:  81.7058% | Elapsed:     6s
Validation | Loss:     0.8318 | Accuracy:  72.0327% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.5956 | Accuracy:  79.7281% | Elapsed:     6s
Validation | Loss:     1.1263 | Accuracy:  62.4829% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     0.5734 | Accuracy:  80.0165% | Elapsed:     6s
Validation | Loss:     0.8945 | Accuracy:  71.0778% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5535 | Accuracy:  81.0466% | Elapsed:     6s
Validation | Loss:     1.1468 | Accuracy:  68.3492% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.4608 | Accuracy:  83.6424% | Elapsed:     6s
Validation | Loss:     0.8280 | Accuracy:  70.2592% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.5202 | Accuracy:  82.3239% | Elapsed:     6s
Validation | Loss:     1.0319 | Accuracy:  69.5771% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.5265 | Accuracy:  82.3239% | Elapsed:     6s
Validation | Loss:     0.8853 | Accuracy:  68.3492% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.5896 | Accuracy:  80.1813% | Elapsed:     6s
Validation | Loss:     1.1431 | Accuracy:  60.9823% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.4808 | Accuracy:  84.0544% | Elapsed:     6s
Validation | Loss:     0.9353 | Accuracy:  72.9877% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.4149 | Accuracy:  85.8673% | Elapsed:     6s
Validation | Loss:     0.8156 | Accuracy:  73.1241% | Elapsed:     1s
Epoch 00033: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.3152 | Accuracy:  90.4821% | Elapsed:     6s
Validation | Loss:     0.8379 | Accuracy:  74.0791% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.2725 | Accuracy:  91.2649% | Elapsed:     6s
Validation | Loss:     0.8106 | Accuracy:  75.5798% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.2480 | Accuracy:  92.1714% | Elapsed:     6s
Validation | Loss:     0.7877 | Accuracy:  75.8527% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.2337 | Accuracy:  92.5834% | Elapsed:     6s
Validation | Loss:     0.8234 | Accuracy:  75.0341% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.2213 | Accuracy:  92.9955% | Elapsed:     6s
Validation | Loss:     0.8582 | Accuracy:  74.7613% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.2045 | Accuracy:  93.4075% | Elapsed:     6s
Validation | Loss:     0.8566 | Accuracy:  74.8977% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.1986 | Accuracy:  94.2316% | Elapsed:     6s
Validation | Loss:     0.8613 | Accuracy:  74.6248% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.1919 | Accuracy:  93.9019% | Elapsed:     6s
Validation | Loss:     0.9683 | Accuracy:  73.9427% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.1920 | Accuracy:  93.7783% | Elapsed:     6s
Validation | Loss:     0.9023 | Accuracy:  75.1705% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.1675 | Accuracy:  95.0556% | Elapsed:     6s
Validation | Loss:     1.0518 | Accuracy:  73.5334% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.1616 | Accuracy:  94.7260% | Elapsed:     6s
Validation | Loss:     1.0702 | Accuracy:  73.2606% | Elapsed:     1s
Epoch 00044: reducing learning rate of group 0 to 1.0000e-05.
--------------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.1449 | Accuracy:  95.6325% | Elapsed:     6s
Validation | Loss:     1.0569 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.1365 | Accuracy:  95.9621% | Elapsed:     6s
Validation | Loss:     1.0560 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.1332 | Accuracy:  96.0033% | Elapsed:     6s
Validation | Loss:     1.0681 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.1306 | Accuracy:  96.1681% | Elapsed:     6s
Validation | Loss:     1.0706 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.1281 | Accuracy:  96.2505% | Elapsed:     6s
Validation | Loss:     1.0881 | Accuracy:  72.8513% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.1263 | Accuracy:  96.3329% | Elapsed:     6s
Validation | Loss:     1.0965 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.1238 | Accuracy:  96.3329% | Elapsed:     6s
Validation | Loss:     1.1097 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.1217 | Accuracy:  96.4565% | Elapsed:     6s
Validation | Loss:     1.1197 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.1195 | Accuracy:  96.6625% | Elapsed:     5s
Validation | Loss:     1.1503 | Accuracy:  73.2606% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.1173 | Accuracy:  96.7037% | Elapsed:     6s
Validation | Loss:     1.1657 | Accuracy:  72.4420% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.1147 | Accuracy:  96.7450% | Elapsed:     6s
Validation | Loss:     1.1781 | Accuracy:  72.8513% | Elapsed:     1s
Epoch 00055: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.1112 | Accuracy:  96.8274% | Elapsed:     6s
Validation | Loss:     1.1838 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.1108 | Accuracy:  96.8274% | Elapsed:     6s
Validation | Loss:     1.1868 | Accuracy:  73.1241% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1104 | Accuracy:  96.8686% | Elapsed:     6s
Validation | Loss:     1.1894 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1101 | Accuracy:  96.8686% | Elapsed:     6s
Validation | Loss:     1.1921 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1098 | Accuracy:  96.8686% | Elapsed:     6s
Validation | Loss:     1.1946 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
```

```
Epoch 61/75
Training   | Loss:     0.1095 | Accuracy:  96.8686% | Elapsed:     6s
Validation | Loss:     1.1967 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1093 | Accuracy:  96.9098% | Elapsed:     6s
Validation | Loss:     1.1979 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1090 | Accuracy:  96.8686% | Elapsed:     6s
Validation | Loss:     1.1991 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1088 | Accuracy:  96.9098% | Elapsed:     6s
Validation | Loss:     1.2017 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1085 | Accuracy:  96.9098% | Elapsed:     6s
Validation | Loss:     1.2024 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1083 | Accuracy:  96.8686% | Elapsed:     6s
Validation | Loss:     1.2059 | Accuracy:  72.5784% | Elapsed:     1s
Epoch 00066: reducing learning rate of group 0 to 1.0000e-07.
---------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1078 | Accuracy:  96.9098% | Elapsed:     6s
Validation | Loss:     1.2060 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1078 | Accuracy:  96.9098% | Elapsed:     6s
Validation | Loss:     1.2061 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1078 | Accuracy:  96.9098% | Elapsed:     6s
Validation | Loss:     1.2062 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1078 | Accuracy:  96.9098% | Elapsed:     6s
Validation | Loss:     1.2064 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1077 | Accuracy:  96.9510% | Elapsed:     6s
Validation | Loss:     1.2064 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1077 | Accuracy:  96.9510% | Elapsed:     6s
Validation | Loss:     1.2065 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1077 | Accuracy:  96.9510% | Elapsed:     6s
Validation | Loss:     1.2067 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1077 | Accuracy:  96.9510% | Elapsed:     6s
Validation | Loss:     1.2069 | Accuracy:  72.5784% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1076 | Accuracy:  96.9510% | Elapsed:     6s
Validation | Loss:     1.2069 | Accuracy:  72.5784% | Elapsed:     1s
===========================================================================
Training complete in 8m 3s
Best model accuracy:  75.85%
===========================================================================
|
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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:     1.8959 | Accuracy:  27.4001% | Elapsed:     6s
Validation | Loss:     1.8970 | Accuracy:  24.6930% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.5640 | Accuracy:  38.4425% | Elapsed:     6s
Validation | Loss:     1.5215 | Accuracy:  44.3383% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.4045 | Accuracy:  45.4883% | Elapsed:     6s
```

```
Validation | Loss:     1.5685 | Accuracy:  39.6999% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.2277 | Accuracy:  53.6465% | Elapsed:     6s
Validation | Loss:     1.5016 | Accuracy:  45.7026% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.2050 | Accuracy:  53.4405% | Elapsed:     6s
Validation | Loss:     1.5216 | Accuracy:  44.4748% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.1509 | Accuracy:  56.7367% | Elapsed:     6s
Validation | Loss:     1.4838 | Accuracy:  48.0218% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.0404 | Accuracy:  61.0218% | Elapsed:     6s
Validation | Loss:     1.2646 | Accuracy:  53.4789% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     0.9829 | Accuracy:  64.1533% | Elapsed:     6s
Validation | Loss:     1.2506 | Accuracy:  54.5703% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.0140 | Accuracy:  63.0820% | Elapsed:     6s
Validation | Loss:     1.1762 | Accuracy:  59.0723% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     0.9423 | Accuracy:  65.8838% | Elapsed:     6s
Validation | Loss:     1.3895 | Accuracy:  51.5689% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     0.8755 | Accuracy:  69.2625% | Elapsed:     6s
Validation | Loss:     1.1036 | Accuracy:  59.3452% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     0.8670 | Accuracy:  68.3560% | Elapsed:     6s
Validation | Loss:     0.9840 | Accuracy:  63.7108% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     0.8110 | Accuracy:  72.0231% | Elapsed:     6s
Validation | Loss:     1.1605 | Accuracy:  61.9372% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     0.7857 | Accuracy:  72.7235% | Elapsed:     6s
Validation | Loss:     0.9906 | Accuracy:  66.5757% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     0.7182 | Accuracy:  74.7013% | Elapsed:     6s
Validation | Loss:     1.0949 | Accuracy:  64.8022% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     0.7285 | Accuracy:  74.9073% | Elapsed:     6s
Validation | Loss:     0.9628 | Accuracy:  68.3492% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     0.8165 | Accuracy:  71.8171% | Elapsed:     6s
Validation | Loss:     1.0522 | Accuracy:  65.7572% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     0.6821 | Accuracy:  76.5554% | Elapsed:     6s
Validation | Loss:     1.0519 | Accuracy:  65.4843% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     0.8096 | Accuracy:  71.1578% | Elapsed:     6s
Validation | Loss:     1.3168 | Accuracy:  62.3465% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     0.7385 | Accuracy:  74.7425% | Elapsed:     6s
Validation | Loss:     1.1776 | Accuracy:  60.3001% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     0.7821 | Accuracy:  72.8471% | Elapsed:     6s
Validation | Loss:     1.1207 | Accuracy:  59.7544% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     0.6800 | Accuracy:  77.3383% | Elapsed:     6s
Validation | Loss:     1.0944 | Accuracy:  65.7572% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     0.6408 | Accuracy:  78.3684% | Elapsed:     6s
Validation | Loss:     0.9342 | Accuracy:  71.2142% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     0.6393 | Accuracy:  78.2035% | Elapsed:     6s
Validation | Loss:     1.0515 | Accuracy:  64.5293% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     0.7857 | Accuracy:  72.0231% | Elapsed:     6s
Validation | Loss:     1.1069 | Accuracy:  69.7135% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
```

```
Training   | Loss:     0.7519 | Accuracy:  74.6601% | Elapsed:     6s
Validation | Loss:     1.1046 | Accuracy:  65.2115% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     0.5800 | Accuracy:  80.7169% | Elapsed:     6s
Validation | Loss:     0.9734 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     0.5852 | Accuracy:  79.8929% | Elapsed:     6s
Validation | Loss:     1.0786 | Accuracy:  68.2128% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     0.6453 | Accuracy:  79.1924% | Elapsed:     6s
Validation | Loss:     1.0579 | Accuracy:  62.2101% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     0.8293 | Accuracy:  69.9629% | Elapsed:     6s
Validation | Loss:     1.0360 | Accuracy:  61.5280% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     0.7231 | Accuracy:  74.4129% | Elapsed:     6s
Validation | Loss:     1.4341 | Accuracy:  57.9809% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     0.6634 | Accuracy:  77.4207% | Elapsed:     6s
Validation | Loss:     1.0235 | Accuracy:  68.4857% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     0.6789 | Accuracy:  77.5855% | Elapsed:     6s
Validation | Loss:     1.0490 | Accuracy:  63.1651% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     0.5853 | Accuracy:  81.1290% | Elapsed:     6s
Validation | Loss:     0.9717 | Accuracy:  68.7585% | Elapsed:     1s
Epoch 00034: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     0.4283 | Accuracy:  87.1034% | Elapsed:     6s
Validation | Loss:     0.9446 | Accuracy:  70.8049% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 36/75
Training   | Loss:     0.3884 | Accuracy:  88.6691% | Elapsed:     6s
Validation | Loss:     0.9198 | Accuracy:  72.7149% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     0.3714 | Accuracy:  88.5867% | Elapsed:     6s
Validation | Loss:     1.0121 | Accuracy:  69.5771% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     0.3578 | Accuracy:  88.8340% | Elapsed:     6s
Validation | Loss:     0.9691 | Accuracy:  71.6235% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     0.3296 | Accuracy:  90.0700% | Elapsed:     6s
Validation | Loss:     1.0111 | Accuracy:  70.2592% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.3224 | Accuracy:  90.1937% | Elapsed:     6s
Validation | Loss:     0.9442 | Accuracy:  72.1692% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     0.3097 | Accuracy:  90.2349% | Elapsed:     6s
Validation | Loss:     1.0762 | Accuracy:  70.9413% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     0.3051 | Accuracy:  90.6057% | Elapsed:     6s
Validation | Loss:     1.0258 | Accuracy:  71.8963% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.3027 | Accuracy:  90.7705% | Elapsed:     6s
Validation | Loss:     0.9515 | Accuracy:  72.4420% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.2938 | Accuracy:  90.8529% | Elapsed:     6s
Validation | Loss:     1.0279 | Accuracy:  70.6685% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.2809 | Accuracy:  91.8006% | Elapsed:     6s
Validation | Loss:     1.0097 | Accuracy:  73.2606% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.2713 | Accuracy:  91.8418% | Elapsed:     6s
Validation | Loss:     1.1072 | Accuracy:  71.4870% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     0.2699 | Accuracy:  91.8830% | Elapsed:     6s
Validation | Loss:     1.1270 | Accuracy:  71.6235% | Elapsed:     1s
Epoch 00047: reducing learning rate of group 0 to 1.0000e-05.
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     0.2357 | Accuracy:  93.0779% | Elapsed:     6s
```

```
Validation | Loss:     1.1194 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     0.2280 | Accuracy:  93.2015% | Elapsed:     6s
Validation | Loss:     1.1336 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     0.2226 | Accuracy:  93.4899% | Elapsed:     6s
Validation | Loss:     1.1186 | Accuracy:  72.0327% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.2197 | Accuracy:  93.7371% | Elapsed:     6s
Validation | Loss:     1.1326 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.2169 | Accuracy:  93.7783% | Elapsed:     6s
Validation | Loss:     1.1222 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.2138 | Accuracy:  93.7783% | Elapsed:     5s
Validation | Loss:     1.1800 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.2105 | Accuracy:  93.9431% | Elapsed:     6s
Validation | Loss:     1.1591 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.2077 | Accuracy:  93.9843% | Elapsed:     6s
Validation | Loss:     1.1579 | Accuracy:  71.8963% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.2047 | Accuracy:  94.1904% | Elapsed:     6s
Validation | Loss:     1.1951 | Accuracy:  72.1692% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.2013 | Accuracy:  94.2728% | Elapsed:     6s
Validation | Loss:     1.1522 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.1973 | Accuracy:  94.3964% | Elapsed:     6s
Validation | Loss:     1.1517 | Accuracy:  72.8513% | Elapsed:     1s
Epoch 00058: reducing learning rate of group 0 to 1.0000e-06.
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.1923 | Accuracy:  94.6436% | Elapsed:     6s
Validation | Loss:     1.1715 | Accuracy:  72.9877% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.1913 | Accuracy:  94.6848% | Elapsed:     6s
Validation | Loss:     1.1829 | Accuracy:  72.7149% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.1907 | Accuracy:  94.6848% | Elapsed:     6s
Validation | Loss:     1.1882 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.1903 | Accuracy:  94.6024% | Elapsed:     6s
Validation | Loss:     1.1934 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.1899 | Accuracy:  94.6436% | Elapsed:     6s
Validation | Loss:     1.1958 | Accuracy:  72.5784% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.1894 | Accuracy:  94.6848% | Elapsed:     6s
Validation | Loss:     1.1983 | Accuracy:  72.4420% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.1890 | Accuracy:  94.6848% | Elapsed:     6s
Validation | Loss:     1.2017 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.1886 | Accuracy:  94.8084% | Elapsed:     6s
Validation | Loss:     1.2021 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.1882 | Accuracy:  94.7260% | Elapsed:     6s
Validation | Loss:     1.2041 | Accuracy:  72.4420% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.1877 | Accuracy:  94.6848% | Elapsed:     6s
Validation | Loss:     1.2059 | Accuracy:  72.3056% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.1874 | Accuracy:  94.7672% | Elapsed:     6s
Validation | Loss:     1.2060 | Accuracy:  72.4420% | Elapsed:     1s
Epoch 00069: reducing learning rate of group 0 to 1.0000e-07.
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.1866 | Accuracy:  94.8908% | Elapsed:     6s
Validation | Loss:     1.2062 | Accuracy:  72.4420% | Elapsed:     1s
```

```
------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.1866 | Accuracy:  94.8496% | Elapsed:     6s
Validation | Loss:     1.2062 | Accuracy:  72.4420% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.1866 | Accuracy:  94.8908% | Elapsed:     6s
Validation | Loss:     1.2066 | Accuracy:  72.4420% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.1865 | Accuracy:  94.8908% | Elapsed:     6s
Validation | Loss:     1.2066 | Accuracy:  72.4420% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.1865 | Accuracy:  94.8908% | Elapsed:     6s
Validation | Loss:     1.2068 | Accuracy:  72.4420% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.1864 | Accuracy:  94.8908% | Elapsed:     6s
Validation | Loss:     1.2069 | Accuracy:  72.4420% | Elapsed:     1s
==============================================================================
Training complete in 8m 8s
Best model accuracy:  73.26%
==============================================================================
|
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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:     2.0071 | Accuracy:  22.2085% | Elapsed:     6s
Validation | Loss:     1.9737 | Accuracy:  19.3724% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 2/75
Training   | Loss:     1.8772 | Accuracy:  26.4112% | Elapsed:     6s
Validation | Loss:     1.8923 | Accuracy:  26.8759% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 3/75
Training   | Loss:     1.7334 | Accuracy:  33.7454% | Elapsed:     6s
Validation | Loss:     1.7753 | Accuracy:  37.9263% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 4/75
Training   | Loss:     1.7045 | Accuracy:  33.0037% | Elapsed:     6s
Validation | Loss:     1.7556 | Accuracy:  35.6071% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 5/75
Training   | Loss:     1.5699 | Accuracy:  38.3189% | Elapsed:     6s
Validation | Loss:     1.6533 | Accuracy:  36.0164% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 6/75
Training   | Loss:     1.5235 | Accuracy:  42.5216% | Elapsed:     6s
Validation | Loss:     1.6298 | Accuracy:  39.8363% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 7/75
Training   | Loss:     1.5676 | Accuracy:  40.3791% | Elapsed:     5s
Validation | Loss:     1.6067 | Accuracy:  38.4720% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 8/75
Training   | Loss:     1.4783 | Accuracy:  43.0161% | Elapsed:     6s
Validation | Loss:     1.6214 | Accuracy:  36.4256% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 9/75
Training   | Loss:     1.3851 | Accuracy:  46.2299% | Elapsed:     6s
Validation | Loss:     1.4360 | Accuracy:  43.5198% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 10/75
Training   | Loss:     1.4134 | Accuracy:  45.9415% | Elapsed:     6s
Validation | Loss:     1.7245 | Accuracy:  32.8786% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 11/75
Training   | Loss:     1.5117 | Accuracy:  42.5216% | Elapsed:     6s
Validation | Loss:     1.6985 | Accuracy:  32.0600% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 12/75
Training   | Loss:     1.4039 | Accuracy:  49.3201% | Elapsed:     6s
Validation | Loss:     1.4972 | Accuracy:  48.1583% | Elapsed:     1s
------------------------------------------------------------------------------
Epoch 13/75
Training   | Loss:     1.4546 | Accuracy:  44.6642% | Elapsed:     6s
```

```
Validation | Loss:     1.8245 | Accuracy:  37.3806% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 14/75
Training   | Loss:     1.3377 | Accuracy:  49.1965% | Elapsed:     6s
Validation | Loss:     1.7513 | Accuracy:  37.2442% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 15/75
Training   | Loss:     1.2481 | Accuracy:  52.9872% | Elapsed:     6s
Validation | Loss:     1.5158 | Accuracy:  43.6562% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 16/75
Training   | Loss:     1.3504 | Accuracy:  47.7544% | Elapsed:     6s
Validation | Loss:     1.4998 | Accuracy:  47.8854% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 17/75
Training   | Loss:     1.2442 | Accuracy:  53.1520% | Elapsed:     6s
Validation | Loss:     1.4850 | Accuracy:  45.9754% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 18/75
Training   | Loss:     1.2259 | Accuracy:  55.2946% | Elapsed:     6s
Validation | Loss:     1.3944 | Accuracy:  48.9768% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 19/75
Training   | Loss:     1.2367 | Accuracy:  54.1821% | Elapsed:     6s
Validation | Loss:     1.5930 | Accuracy:  44.0655% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 20/75
Training   | Loss:     1.1823 | Accuracy:  56.5307% | Elapsed:     6s
Validation | Loss:     1.5403 | Accuracy:  42.5648% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 21/75
Training   | Loss:     1.1347 | Accuracy:  59.6621% | Elapsed:     6s
Validation | Loss:     1.4739 | Accuracy:  45.0205% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 22/75
Training   | Loss:     1.2249 | Accuracy:  54.2645% | Elapsed:     5s
Validation | Loss:     1.2726 | Accuracy:  55.5252% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 23/75
Training   | Loss:     1.1752 | Accuracy:  57.0251% | Elapsed:     6s
Validation | Loss:     1.5845 | Accuracy:  38.1992% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 24/75
Training   | Loss:     1.4024 | Accuracy:  47.7956% | Elapsed:     6s
Validation | Loss:     1.7770 | Accuracy:  36.6985% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 25/75
Training   | Loss:     1.2610 | Accuracy:  54.3057% | Elapsed:     6s
Validation | Loss:     1.5438 | Accuracy:  47.3397% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 26/75
Training   | Loss:     1.1763 | Accuracy:  56.5307% | Elapsed:     4s
Validation | Loss:     1.4130 | Accuracy:  44.8840% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 27/75
Training   | Loss:     1.1254 | Accuracy:  59.8681% | Elapsed:     4s
Validation | Loss:     1.2528 | Accuracy:  54.2974% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 28/75
Training   | Loss:     1.1517 | Accuracy:  59.7445% | Elapsed:     4s
Validation | Loss:     1.3951 | Accuracy:  49.6589% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 29/75
Training   | Loss:     1.3407 | Accuracy:  50.7623% | Elapsed:     4s
Validation | Loss:     1.4429 | Accuracy:  44.6112% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 30/75
Training   | Loss:     1.2574 | Accuracy:  53.3993% | Elapsed:     4s
Validation | Loss:     1.3073 | Accuracy:  48.7040% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 31/75
Training   | Loss:     1.1470 | Accuracy:  58.0552% | Elapsed:     4s
Validation | Loss:     1.2349 | Accuracy:  53.0696% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 32/75
Training   | Loss:     1.1967 | Accuracy:  56.4483% | Elapsed:     3s
Validation | Loss:     1.5449 | Accuracy:  45.7026% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 33/75
Training   | Loss:     1.1822 | Accuracy:  56.4071% | Elapsed:     3s
Validation | Loss:     1.4500 | Accuracy:  49.1132% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 34/75
Training   | Loss:     1.0878 | Accuracy:  59.0853% | Elapsed:     3s
Validation | Loss:     1.3201 | Accuracy:  53.7517% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 35/75
Training   | Loss:     1.0649 | Accuracy:  62.2991% | Elapsed:     3s
Validation | Loss:     1.2170 | Accuracy:  53.2060% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 36/75
```

```
Training   | Loss:     1.0596 | Accuracy:  62.0931% | Elapsed:     3s
Validation | Loss:     1.1972 | Accuracy:  54.8431% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 37/75
Training   | Loss:     1.0947 | Accuracy:  62.2579% | Elapsed:     3s
Validation | Loss:     1.2421 | Accuracy:  55.7981% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 38/75
Training   | Loss:     1.0401 | Accuracy:  62.8760% | Elapsed:     3s
Validation | Loss:     1.3101 | Accuracy:  49.6589% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 39/75
Training   | Loss:     1.0449 | Accuracy:  61.8047% | Elapsed:     4s
Validation | Loss:     1.1018 | Accuracy:  56.2074% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 40/75
Training   | Loss:     0.9832 | Accuracy:  65.6778% | Elapsed:     4s
Validation | Loss:     1.2213 | Accuracy:  58.9359% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 41/75
Training   | Loss:     1.0768 | Accuracy:  62.2167% | Elapsed:     4s
Validation | Loss:     1.2676 | Accuracy:  51.9782% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 42/75
Training   | Loss:     1.0526 | Accuracy:  61.9695% | Elapsed:     3s
Validation | Loss:     1.2792 | Accuracy:  52.5239% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 43/75
Training   | Loss:     0.9578 | Accuracy:  66.7079% | Elapsed:     3s
Validation | Loss:     1.2059 | Accuracy:  54.4338% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 44/75
Training   | Loss:     0.9456 | Accuracy:  67.1199% | Elapsed:     3s
Validation | Loss:     1.1056 | Accuracy:  61.9372% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 45/75
Training   | Loss:     0.9749 | Accuracy:  65.7190% | Elapsed:     3s
Validation | Loss:     1.3835 | Accuracy:  51.2960% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 46/75
Training   | Loss:     0.9382 | Accuracy:  66.3370% | Elapsed:     3s
Validation | Loss:     1.2065 | Accuracy:  56.7531% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 47/75
Training   | Loss:     1.4391 | Accuracy:  49.2789% | Elapsed:     3s
Validation | Loss:     1.5393 | Accuracy:  42.9741% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 48/75
Training   | Loss:     1.4091 | Accuracy:  47.8780% | Elapsed:     4s
Validation | Loss:     1.6247 | Accuracy:  40.1091% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 49/75
Training   | Loss:     1.2329 | Accuracy:  55.7066% | Elapsed:     4s
Validation | Loss:     1.2133 | Accuracy:  53.2060% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 50/75
Training   | Loss:     1.1814 | Accuracy:  58.5084% | Elapsed:     4s
Validation | Loss:     1.4449 | Accuracy:  45.9754% | Elapsed:     1s
Epoch 00050: reducing learning rate of group 0 to 1.0000e-04.
---------------------------------------------------------------------------
Epoch 51/75
Training   | Loss:     0.9138 | Accuracy:  69.7157% | Elapsed:     4s
Validation | Loss:     1.2317 | Accuracy:  57.9809% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 52/75
Training   | Loss:     0.8593 | Accuracy:  71.6522% | Elapsed:     4s
Validation | Loss:     1.2321 | Accuracy:  54.4338% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 53/75
Training   | Loss:     0.8408 | Accuracy:  72.3939% | Elapsed:     4s
Validation | Loss:     1.1805 | Accuracy:  57.7080% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 54/75
Training   | Loss:     0.8146 | Accuracy:  74.1244% | Elapsed:     4s
Validation | Loss:     1.2066 | Accuracy:  59.4816% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 55/75
Training   | Loss:     0.7957 | Accuracy:  74.1656% | Elapsed:     4s
Validation | Loss:     1.1649 | Accuracy:  60.0273% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 56/75
Training   | Loss:     0.7804 | Accuracy:  74.9485% | Elapsed:     4s
Validation | Loss:     1.2208 | Accuracy:  56.3438% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 57/75
Training   | Loss:     0.7787 | Accuracy:  74.7013% | Elapsed:     4s
Validation | Loss:     1.1130 | Accuracy:  61.6644% | Elapsed:     1s
---------------------------------------------------------------------------
Epoch 58/75
Training   | Loss:     0.7720 | Accuracy:  74.7425% | Elapsed:     4s
Validation | Loss:     1.1003 | Accuracy:  61.3915% | Elapsed:     1s
```

```
--------------------------------------------------------------------------------
Epoch 59/75
Training   | Loss:     0.7509 | Accuracy:  75.6902% | Elapsed:     4s
Validation | Loss:     1.2398 | Accuracy:  61.1187% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 60/75
Training   | Loss:     0.7487 | Accuracy:  75.2781% | Elapsed:     4s
Validation | Loss:     1.2160 | Accuracy:  57.9809% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 61/75
Training   | Loss:     0.7621 | Accuracy:  74.3717% | Elapsed:     4s
Validation | Loss:     1.1405 | Accuracy:  60.1637% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 62/75
Training   | Loss:     0.7289 | Accuracy:  76.5142% | Elapsed:     4s
Validation | Loss:     1.0694 | Accuracy:  64.3929% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 63/75
Training   | Loss:     0.7326 | Accuracy:  75.8138% | Elapsed:     6s
Validation | Loss:     1.0232 | Accuracy:  64.6658% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 64/75
Training   | Loss:     0.7300 | Accuracy:  76.0610% | Elapsed:     6s
Validation | Loss:     1.0542 | Accuracy:  63.9836% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 65/75
Training   | Loss:     0.7283 | Accuracy:  76.4730% | Elapsed:     6s
Validation | Loss:     1.2176 | Accuracy:  58.1173% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 66/75
Training   | Loss:     0.7184 | Accuracy:  76.4318% | Elapsed:     6s
Validation | Loss:     1.1257 | Accuracy:  63.3015% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 67/75
Training   | Loss:     0.7151 | Accuracy:  76.1022% | Elapsed:     6s
Validation | Loss:     1.1275 | Accuracy:  63.7108% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 68/75
Training   | Loss:     0.6905 | Accuracy:  78.2035% | Elapsed:     6s
Validation | Loss:     1.1565 | Accuracy:  62.0737% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 69/75
Training   | Loss:     0.6926 | Accuracy:  77.9151% | Elapsed:     6s
Validation | Loss:     1.1986 | Accuracy:  59.8909% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 70/75
Training   | Loss:     0.6948 | Accuracy:  77.7091% | Elapsed:     6s
Validation | Loss:     1.0577 | Accuracy:  64.1201% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 71/75
Training   | Loss:     0.6593 | Accuracy:  79.4396% | Elapsed:     6s
Validation | Loss:     1.1496 | Accuracy:  63.3015% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 72/75
Training   | Loss:     0.6639 | Accuracy:  79.3160% | Elapsed:     6s
Validation | Loss:     1.0176 | Accuracy:  65.3479% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 73/75
Training   | Loss:     0.6658 | Accuracy:  78.6568% | Elapsed:     6s
Validation | Loss:     1.0217 | Accuracy:  68.3492% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 74/75
Training   | Loss:     0.6746 | Accuracy:  78.5332% | Elapsed:     6s
Validation | Loss:     1.1041 | Accuracy:  63.7108% | Elapsed:     1s
--------------------------------------------------------------------------------
Epoch 75/75
Training   | Loss:     0.6627 | Accuracy:  78.6156% | Elapsed:     6s
Validation | Loss:     1.1843 | Accuracy:  61.3915% | Elapsed:     1s
================================================================================
Training complete in 6m 39s
Best model accuracy:  68.35%
================================================================================
```

Hyper-parameter Grid Search Details

In [22]:

```
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[22]: Show 10 entries

Search:

Hidden_Size	RNN_Layers	L2_Reg_Weight	Val_Loss	Val_Accuracy
128	1	0.0001	0.777879	0.739427
128	1	0.001	0.723883	0.77899
128	1	0.01	1.061971	0.710778
128	2	0.0001	0.897763	0.73397
128	2	0.001	1.048879	0.716235
128	2	0.01	1.188421	0.609823
256	1	0.0001	0.685082	0.774898
256	1	0.001	0.665994	0.781719
256	1	0.01	0.932227	0.721692
256	2	0.0001	0.940946	0.718963

Showing 1 to 10 of 18 entries

Previous 1 2 Next

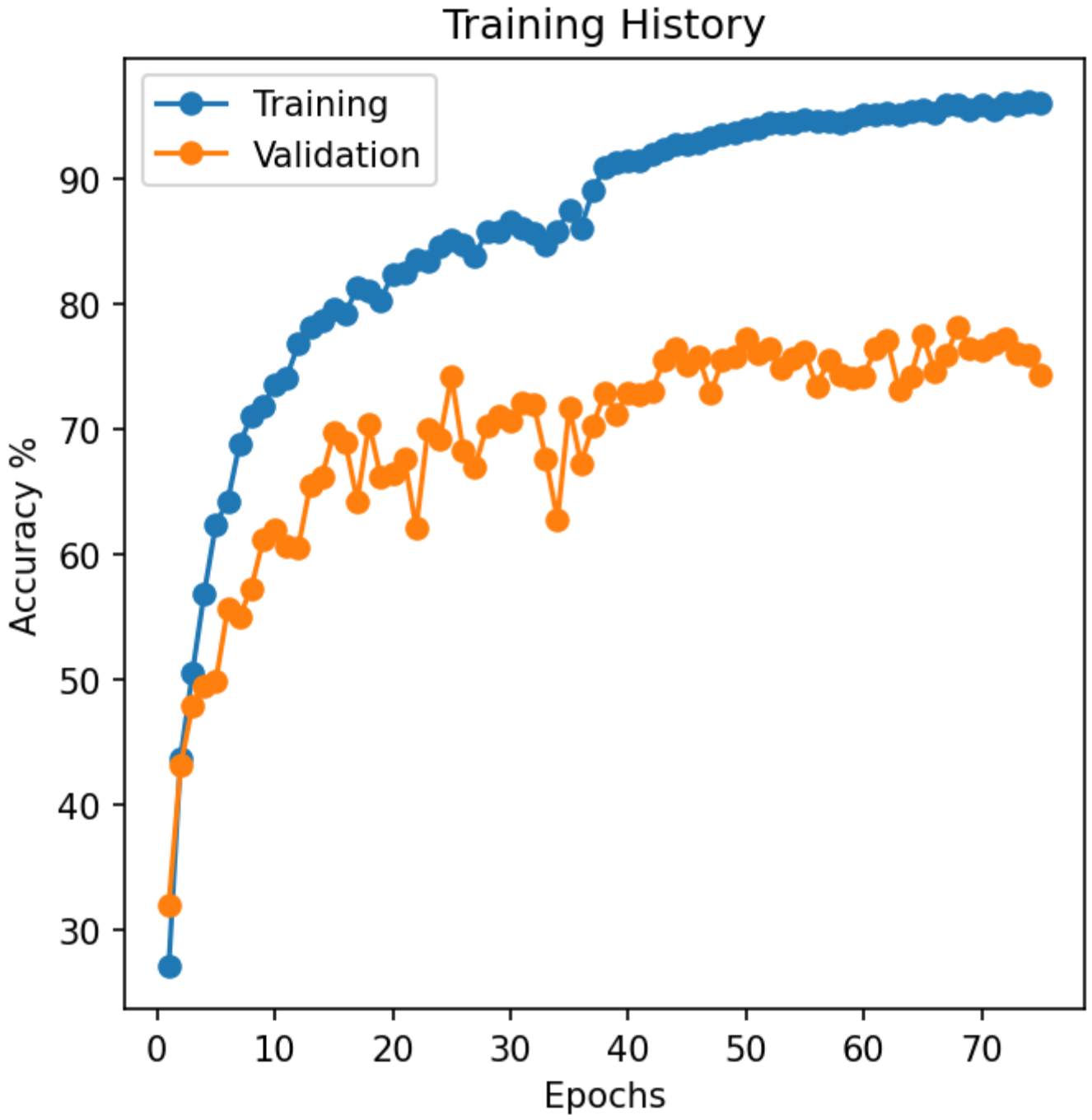
Best Trial Hyper-parameters

In [23]:
```
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 [24]:
```
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 [25]:
```
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

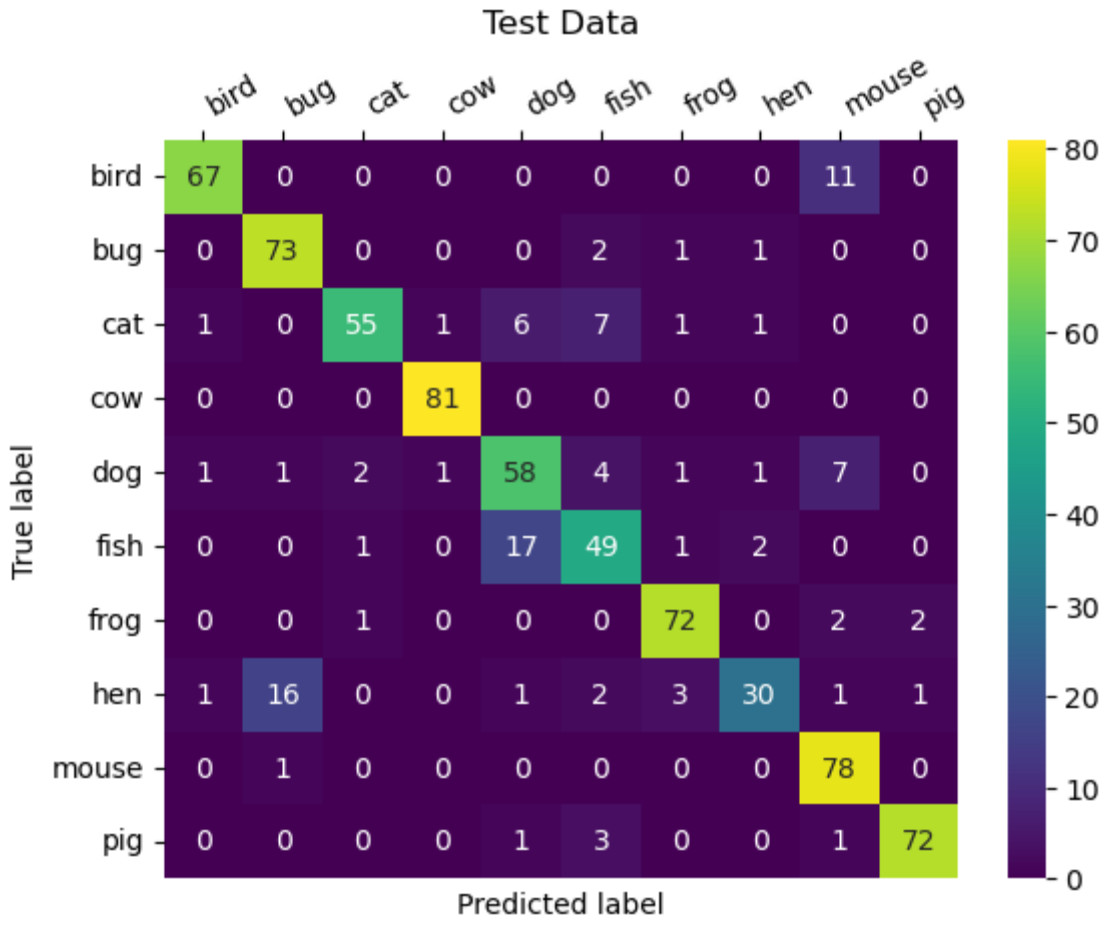
print(f'Test Data | Loss: {testLoss:10.4f} Accuracy: {testAccuracy*100:10.4f}%')
```

```
Test Data | Loss:     0.4630 Accuracy:    85.5795%
```

Best Trial Test Confusion Matrix

In [26]:
```
CM=confusion_matrix(actual, predicted)
class_names=uniqueTarget
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
bird
bug
cat
cow
dog
fish
frog
hen
mouse
pig
True label
Predicted label
67 0 0 0 0 0 0 0 11 0
0 73 0 0 0 2 1 1 0 0
1 0 55 1 6 7 1 1 0 0
0 0 0 81 0 0 0 0 0 0
1 1 2 1 58 4 1 1 7 0
0 0 1 0 17 49 1 2 0 0
0 0 1 0 0 0 72 0 2 2
1 16 0 0 1 2 3 30 1 1
0 1 0 0 0 0 0 0 78 0
0 0 0 0 1 3 0 0 1 72
80
70
60
50
40
30
20
10
0